МІНІСТЕРСТВО ОСВІТИ І НАУКИ, МОЛОДІ ТА СПОРТУ УКРАЇНИ

Харківська національна академія міського господарства

ТЕКСТИ І ТЕСТОВІ ЗАВДАННЯ

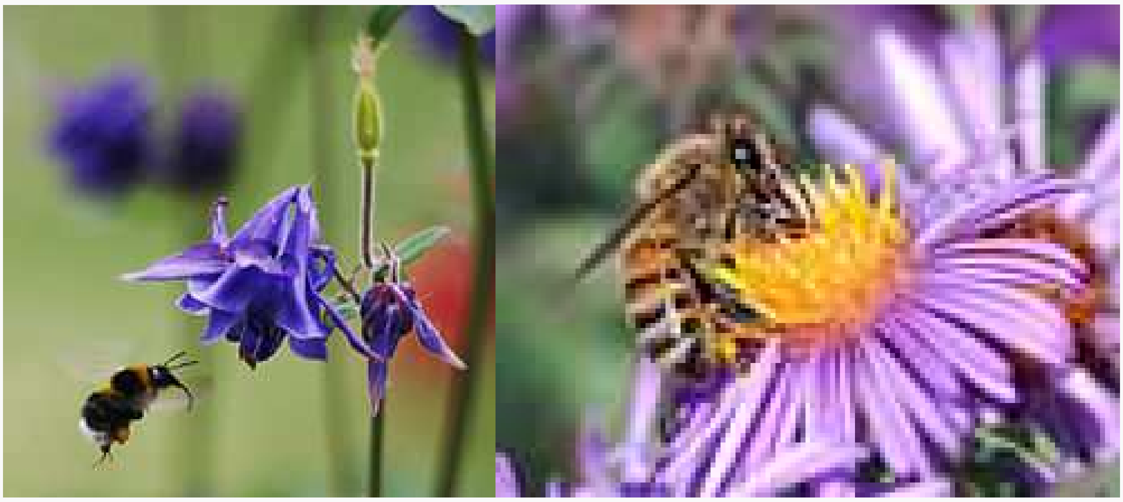
ДЛЯ САМОСТІЙНОЇ РОБОТИ

з дисципліни

"Ділова іноземна мова"

(англійська мова)

(для студентів 3 курсу денної форми навчання напряму підготовки 6.040106 – "Екологія, охорона навколишнього середовища та збалансоване природокористування")



Харків – ХНАМГ – 2013

Тексти і тестові завдання для самостійної роботи з дисципліни “Ділова іноземна мова” (англійська мова) (для студентів 3 курсу денної форми навчання напряму підготовки 6.040106 – “**Екологія, охорона навколишнього середовища та збалансоване природокористування**”) / Харк. нац. акад. міськ. госп-ва; уклад.: О. В. Маматова. – Х.: ХНАМГ, 2013 – 71 с.

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Рекомендовано кафедрою іноземних мов,
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INTRODUCTION

These **tests** for **self-study** have been specially designed to provide essential practice for students specializing in **Ecology, Environmental Protection and Balanced Exploitation of Natural Resources.**

The course consists of a great variety of **texts** and 7 **tests** for **self-study**.

The specific benefits of this method of presentation are as follows:

1. It provides the reader with a quick, efficient, and effective means of grasping the essential subject matter.
2. It keeps the reader *active* in the learning process and increases comprehension level.

These tests can be used for self-study, to check language and to offer a diagnostic for the students' language development.

When teachers use texts for reading, they are often too concerned with what was written at the expense of *how*. Reading in any language is an affective as well as a cognitive process. The teacher's role is not that of corrector or judge, but rather that of enabler. The teacher assists with language, error, but should not replace the student's perceptions with his or her own.

The teacher who brings these instructions into the study is not depriving the students of language practice, but is, instead, providing a richer context for such practice.

To facilitate the students' self-study, a comprehensive **list of references** has been appended.

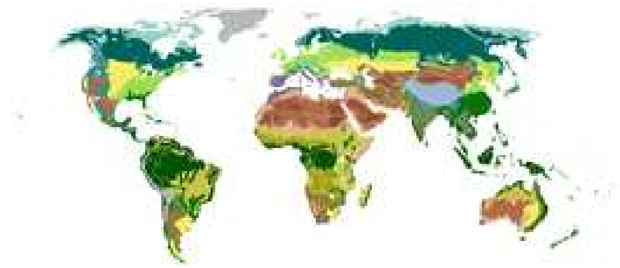
All the students can be directed to **the Wordlist.**

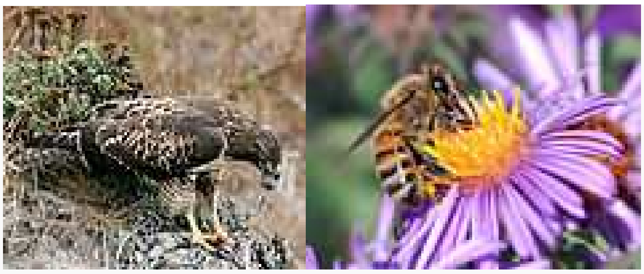
Part A **TEXT 1**

History of Ecology

From Wikipedia, the free encyclopedia

Read and translate the text using a dictionary





The scientific discipline of **Ecology** encompasses areas from global processes (above), to the study of marine and terrestrial habitats (middle) to interspecific interactions such as predation and pollination (below).

Ecology (from Greek: οἶκος, '**house**'; -λογία, 'study of') is the scientific study of the relation of living organisms to each other and their surroundings. Ecology includes the study of plant and animal populations, plant and animal communities and ecosystems. Ecologists study a range of living phenomena from the role of bacteria in nutrient recycling to the effects of tropical rain forest on the Earth's atmosphere.

The word ‘ecology’ (‘oekologie’) was coined by the German scientist Ernst Haeckel 1834–1919. Haeckel was a zoologist, artist, writer, and later in life the professor of comparative anatomy. Ecology is a sub-discipline of biology, which is the study of life, branching out from the natural sciences in the late 19th century. Ecology is not synonymous with environment, environmentalism, natural history or environmental science. Ecology is closely related to the biological disciplines of physiology, evolution, genetics and behaviour. Ecology seeks to explain:

- life processes and adaptations
- distribution and abundance of organisms
- the movement of materials and energy through living communities
- the successional development of ecosystems
- the abundance and distribution of biodiversity in context of the environment.

There are many practical applications of ecology in conservation biology, wetland management, natural resource management (agriculture, forestry, fisheries), city planning (urban ecology), community health, economics, basic & applied science and it provides a conceptual framework for understanding and researching human social interaction (human ecology).

The 18th and 19th century ~ Ecological Murmurs

The Botanical Geography and Alexander von Humboldt

Throughout the 18th and the beginning of the 19th century, the great maritime powers such as Britain, Spain, and Portugal launched many world exploratory expeditions to develop maritime commerce with other countries, and to discover new natural resources, as well as to catalogue them. At the beginning of the 18th century, about twenty thousand plant species were known, versus forty thousand at the beginning of the 19th century, and almost 400,000 today. These expeditions were joined by many scientists, including botanists, such as the German explorer Alexander von Humboldt. Humboldt is often considered a father of ecology. He was the first to take on the study of the relationship between organisms and their environment. He exposed the existing relationships between observed plant species and climate, and described vegetation zones using latitude and altitude, a discipline now known as geobotany. Other important botanists of the time included Aimé Bonpland. In 1856, the Park Grass Experiment was established at the Rothamsted Experimental Station to test the effect of fertilizers and manure on hay yields.

Ecology is generally spoken of as a new science, having only become prominent in the second half of the 20th century. More precisely, there is agreement that ecology emerged as a distinct discipline at the turn of the 20th century, and that it gained public prominence in the 1960s, due to widespread concern for the state of the environment. Nonetheless, ecological thinking at some level has been around for a long time, and the principles of ecology have developed gradually, closely intertwined with the development of other biological disciplines. Thus, one of the first ecologists may have been Aristotle or perhaps his student, Theophrastus, both of whom had interest in many species of animals. Theophrastus described interrelationships between animals and between animals and their environment as early as the 4th century BC (Ramalay, 1940).

TEST 1

Part B

STRUCTURE AND WRITTEN EXPRESSION

Directions: In this part each problem consists of an incomplete sentence. Below the sentence are four choices marked (A), (B), (C), and (D). You should find the one choice which best completes the sentence.

1. Ecologists study … range of living phenomena from the role of bacteria in nutrient recycling to the effects of tropical rain forest on the Earth's atmosphere.

(A) a
(B) an
(C) the
(D) –

2. The scientific discipline of … encompasses areas from global processes (above), to the study of marine and terrestrial habitats (middle) to interspecific interactions such as predation and pollination (below).

(A) Ecology
(B) Botany
(C) Biology
(D) Physics

3. The word 'ecology' ('oekologie') … by the German scientist Ernst Haeckel 1834–1919.

(A) were being coined
(B) was being coined
(C) were coined
(D) was coined

4. Thus, one of the first ecologists … Aristotle or perhaps his student, Theophrastus, both of whom had interest in many species of animals.
(A) might have been
(B) would have been
(C) will have been
(D) may have been
5. More precisely, … agreement that ecology emerged as a distinct discipline at the turn of the 20th century, and that it gained public prominence in the 1960s, due to widespread concern for the state of the environment.
(A) there was
(B) there were
(C) there are
(D) there is
6. Ecology is closely related … the biological disciplines of physiology, evolution, genetics and behaviour.
(A) of
(B) to
(C) for
(D) with
7. Theophrastus described interrelationships … animals and between animals and their environment as early as the 4th century BC (Ramalay, 1940).
(A) amidst
(B) in the middle of
(C) among
(D) between
8. In 1856, the Park Grass Experiment … at the Rothamsted Experimental Station to test the effect of fertilizers and manures on hay yields.
(A) has been established
(B) had been established
(C) was established
(D) were established
9. Haeckel was a …, artist, writer, and later in life the professor of comparative anatomy.
(A) ecologist
(B) zoologist
(C) botanist
(D) technologist

10. These expeditions were joined by many scientists, including botanists, such as the … explorer Alexander von Humboldt.
(A) Russian
(B) French
(C) German
(D) English

Part A **TEXT 2**

The Notion of Biocoenosis: Wallace and Möbius

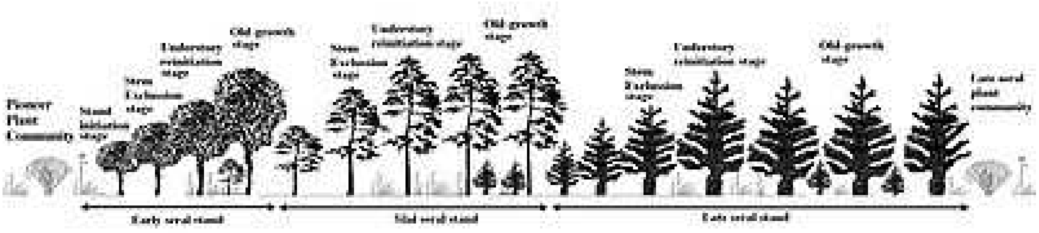
Read and translate the text using a dictionary

Alfred Russel Wallace, contemporary and competitor to Darwin, was first to propose a 'geography' of animal species. Several authors recognized at the time that species were not independent of each other, and grouped them into plant species, animal species, and later into communities of living beings or biocoenosis. The first use of this term is usually attributed to Karl Möbius in 1877, but already in 1825, the French naturalist Adolphe Dureau de la Malle used the term *societé* about an assemblage of plant individuals of different species.

Warming and the Foundation of Ecology as Discipline

While Darwin focused exclusively on competition as a selective force, Eugen Warming devised a new discipline that took abiotic factors, that is drought, fire, salt, cold etc., as seriously as biotic factors in the assembly of biotic communities. Biogeography before Warming was largely of descriptive nature – faunistic or floristic. Warming's aim was, through the study of organism (plant) morphology and anatomy, i.e. adaptation, to explain why a species occurred under a certain set of environmental conditions. Moreover, the goal of the new discipline was to explain why species occupying similar habitats, experiencing similar hazards, would solve problems in similar ways, despite often being of widely different phylogenetic descent. Based on his personal observations in Brazilian cerrado, in Denmark, Norwegian Finnmark and Greenland, Warming gave the first university course in ecological plant geography. Based on his lectures, he wrote the book 'Plantesamfund', which was immediately translated to German, Polish and Russian, later to English as 'Oecology of Plants'. Through its German edition, the book had immense effect on British and North American scientist like Arthur Tansley, Henry Chandler Cowles and Frederic Clements.

Scale and Complexity



Ecosystems regenerate after a disturbance such as fire, forming mosaics of different age groups structured across a landscape. Pictured are different seral stages in forested ecosystems starting from pioneers colonizing a disturbed site and maturing in successional stages leading to old-growth forests.

The processes that influence ecological phenomena vary through space and time. It can take thousands of years for ecological processes to mature; the life-span of a tree, for example, can encompass different successional stages. The ecological process is extended even further through time as trees die, decay and provide habitat as nurse logs or coarse woody debris. The area of an ecosystem can vary greatly from tiny to vast. A single tree is of little consequence to the classification of a forest ecosystem, but it is far more significant to smaller organisms. Several generations of an aphid population can exist over the lifespan of a single leaf. Each of those aphids, in turn support diverse bacterial communities. Tree growth is related to local site variables, such as soil type, moisture content, slope of the land, and forest canopy closure. More complex global factors, such as climate, must be considered for the classification and understanding of processes leading to larger patterns spanning across a forested landscape. Global patterns of biological diversity are complex. This biocomplexity stems from the interplay among ecological processes that operate and influence patterns that grade into each other, such as transitional areas or ecotones that stretch across different scales. ‘Complexity in ecology is of at least six distinct types: spatial, temporal, structural, process, behavioural, and geometric’. There are different views on what constitutes complexity. One perspective lump things that we do not understand into this category by virtue of the computational effort it would require to piece together the numerous interacting parts. Alternatively, complexity in life sciences can be viewed as emergent self-organized systems with multiple possible outcomes directed by random accidents of history. Small scale patterns do not necessarily explain large scale phenomena, otherwise captured in the expression ‘the sum is greater than the parts’. Ecologists have identified emergent and self-organizing phenomena that operate at different environmental scales of influence, ranging from molecular to planetary, and these require different sets of scientific explanation. Long-term ecological studies provide important track records to better understand the complexity of ecosystems over longer temporal and broader spatial scales. The International Long Term Ecological Network manages and exchanges scientific information among research sites. The longest experiment in existence is the Park Grass Experiment that was initiated in 1856. Another example includes the Hubbard Brook study in operation since 1960. To structure the study of ecology into a manageable framework of understanding, the biological world is conceptually organized as a nested hierarchy of organization, ranging in scale from genes, to cells, to tissues, to organs, to organisms, to species and up to the level of the biosphere. Together these hierarchical scales of life form a panarchy. Ecosystems are primarily researched at three key levels of organization—organisms, populations, and communities. Ecologists study ecosystems by sampling a certain number of individuals that are representatives of a population. Ecosystems consist of communities interacting with each other and the environment. In ecology, communities are created by the interaction of the populations of different species in an area. Biodiversity is an attribute of a site or area that consists of the variety within and among biotic communities, whether influenced by humans or not, at any spatial scale from microsites and habitat patches to the entire biosphere. Biodiversity (an abbreviation of biological diversity) describes the diversity of life from genes to ecosystems and spans every level of biological organization. There are many ways to index, measure, and represent biodiversity. Biodiversity includes species diversity, ecosystem diversity, genetic diversity and the complex processes operating at and among these respective levels. Biodiversity plays an important role in ecological health as much as it does for human health. Preventing or prioritizing species extinctions is one way to preserve biodiversity, but populations, the genetic diversity within them and ecological processes, such as migration, are being threatened on global scales and disappearing rapidly as well. Conservation priorities and management techniques require different approaches and considerations to address the full ecological scope of biodiversity. Populations and species migration, for example, are more sensitive indicators of ecosystem services that sustain and contribute natural capital toward the well-being of humanity. An understanding of biodiversity has practical application for ecosystem-based conservation planners as they make ecologically responsible decisions in management recommendations to consultant firms, governments and industry.

Ecological Niche and Habitat

Termite mounds with varied heights of chimneys regulate gas exchange,

temperature and other environmental parameters that are needed to sustain the internal physiology of the entire colony.

There are many definitions of the niche dating back to 1917, but G. Evelyn Hutchinson made conceptual advances in 1957 and introduced the most widely accepted definition: 'The niche is the set of biotic and abiotic conditions in which a species is able to persist and maintain stable population sizes.' The ecological niche is a central concept in the ecology of organisms and is sub-divided into the *fundamental* and the *realized* niche. The fundamental niche is the set of environmental conditions under which a species is able to persist. The realized niche is the set of environmental plus ecological conditions under which a species persists. The habitat of a species is a related but distinct concept that describes the environment over which a species is known to occur and the type of community that is formed as a result. More specifically, 'habitats can be defined as regions in environmental space that are composed of multiple dimensions, each representing a biotic or abiotic environmental variable; that is, any component or characteristic of the environment related directly (e.g. forage biomass and quality) or indirectly (e.g. elevation) to the use of a location by the animal'. For example, the habitat might refer to an aquatic or terrestrial environment that can be further categorized as montane or alpine ecosystems. Biogeographical patterns and range distributions are explained or predicted through knowledge and understanding of a species traits and niche requirements. Species have functional traits that are uniquely adapted to the ecological niche. A trait is a measurable property of an organism that influences its performance. Traits of each species are suited and uniquely adapted to their ecological niche. This means that resident species are at an advantage and able to competitively exclude other similarly adapted species from having an overlapping geographic range. This is called the competitive exclusion principle.

Corals adapt and modify their environment by forming calcium carbonate skeletons that provide *growing conditions for future generations and form habitat for many other species.*

Biodiversity of a coral reef

Organisms are subject to environmental pressures, but they are also modifiers of their habitats. The regulatory feedback between organisms and their environment can modify conditions from local (e.g., a pond) to global scales (e.g., Gaia), over time and even after death, such as decaying logs or silica skeleton deposits from marine organisms. The process and concept of ecosystem engineering has also been called niche construction. Ecosystem engineers are defined as:'...organisms that directly or indirectly modulate the availability of resources to other species, by causing physical state changes in biotic or abiotic materials. In so doing they modify, maintain and create habitats'. The ecosystem engineering concept has stimulated a new appreciation for the degree of influence that organisms have on the ecosystem and evolutionary process. The terms niche construction are more often used in reference to the under appreciated feedback mechanism of natural selection imparting forces on the abiotic niche. An example of natural selection through ecosystem engineering occurs in the nests of social insects, including ants, bees, wasps, and termites. There is an emergent homeostasis in the structure of the nest that regulates, maintains and defends the physiology of the entire colony. Termite mounds, for example, maintain a constant internal temperature through the design of air-conditioning chimneys. The structure of the nests is subject to the forces of natural selection. Moreover, the nest can survive over successive generations, which means that ancestors inherit both genetic material and a legacy niche that was constructed before their time. Diatoms in the Bay of Fundy, Canada, provide another example of an ecosystem engineer. The diatoms cause a physical state change in the properties of the sand that allows other organisms to colonize the area. The concept of ecosystem engineering brings new conceptual implications for the discipline of conservation biology.

TEST 2

Part B

STRUCTURE AND WRITTEN EXPRESSION

Directions: In this part each problem consists of an incomplete sentence. Below the sentence are four choices marked (A), (B), (C), and (D). You should find the one choice which best completes the sentence.

1. … concept of ecosystem engineering brings new conceptual implications for the discipline of conservation biology.

(A) A
(B) An
(C) The
(D) –
2. Corals adapt and modify … environment by forming calcium carbonate skeletons that provide growing conditions for future generations and form habitat for many other species.
(A) his
(B) its
(C) their
(D) our
3. … Darwin focused exclusively on competition as a selective force, Eugen Warming devised a new discipline that took abiotic factors, that is drought, fire, salt, cold etc., as seriously as biotic factors in the assembly of biotic communities.
(A) Although
(B) Thus
(C) However
(D) While
4. Several authors recognized at the time that species were not independent of each other, and grouped them … plant species, animal species, and later into communities of living beings or biocoenosis.
(A) into
(B) in
(C) to
(D) with
5. This means that resident species are at an advantage and able to competitively exclude other similarly adapted species from … an overlapping geographic range.
(A) had
(B) having
(C) have
(D) has
6. Warming's … was, through the study of organism (plant) morphology and anatomy, i.e. adaptation, to explain why a species occurred under a certain set of environmental conditions.
(A) purpose
(B) aim
(C) objective

(D) idea

7. …, the goal of the new discipline was to explain why species occupying similar habitats, experiencing similar hazards, would solve problems in similar ways, despite often being of widely different phylogenetic descent.

(A) Too

(B) Although

(C) However

(D) Moreover

8. For example, the habitat might refer to an aquatic or terrestrial environment that can be … categorized as montane or alpine ecosystems.

(A) farthest

(B) furthest

(C) farther

(D) further

9. More specifically, 'habitats can be defined as regions in environmental space that are composed of multiple dimensions, each representing a biotic or abiotic environmental variable; that is, … component or characteristic of the environment related directly (e.g. forage biomass and quality) or indirectly (e.g. elevation) to the use of a location by the animal'.

(A) no

(B) any

(C) some

(D) –

10. An example of natural selection through ecosystem engineering … in the nests of social insects, including ants, bees, wasps, and termites.

(A) occurring

(B) occurs

(C) occur

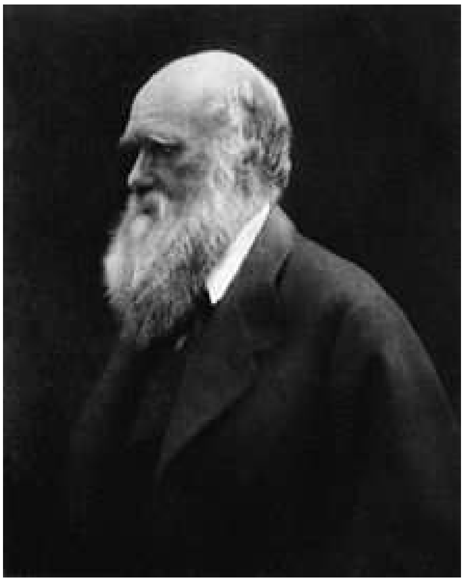
(D) occurred

Part A **TEXT 3**

Darwinism and the Science of Ecology

Read and translate the text using a dictionary

Julia Margaret Cameron's portrait of Darwin



It is often held that the roots of scientific ecology may be traced back to **Darwin**. This contention may look convincing at first glance inasmuch as *On the Origin of Species* is full of observations and proposed mechanisms that clearly fit within the boundaries of modern ecology (e.g. the cat-to-clover chain – an ecological cascade) and because the term ecology was coined in 1866 by a strong proponent of Darwinism, Ernst Haeckel. However, Darwin never used the word in his writings after this year, not even in his most 'ecological' writings such as the foreword to the English edition of Hermann Müller's *The Fertilization of Flowers* (1883) or in his own treatise of earthworms and mull formation in forest soils (The formation of vegetable mould through the action of worms, 1881). Moreover, the pioneers founding ecology as a scientific discipline, such as Eugen Warming, Gaston Bonnier, F. A. Forel, S. A. Forbes and Karl Möbius, made almost no reference to Darwin's ideas in their works. This was clearly not out of ignorance or because the works of Darwin were not widespread, but because ecology from the beginning was concerned with the relationship between organism morphology and physiology on one side and environment on the other, mainly abiotic environment, hence environmental selection. Darwin's concept of natural selection on the other hand focused primarily on competition. The mechanisms other than competition that he described, primarily the divergence of character which can reduce competition and his statement that 'struggle' as he used it was metaphorical and thus included environmental selection, were given less emphasis in the Origin than competition. Despite most portrayals of Darwin conveying him as a non-aggressive recluse who let others fight his battles, Darwin remained all his life a man nearly obsessed with the ideas of competition, struggle and conquest – with all forms of human contact as confrontation.

Early 20th Century ~ Expansion of Ecological Thought

The Biosphere – Eduard Suess, Henry Chandler Cowles, and Vladimir Vernadsky

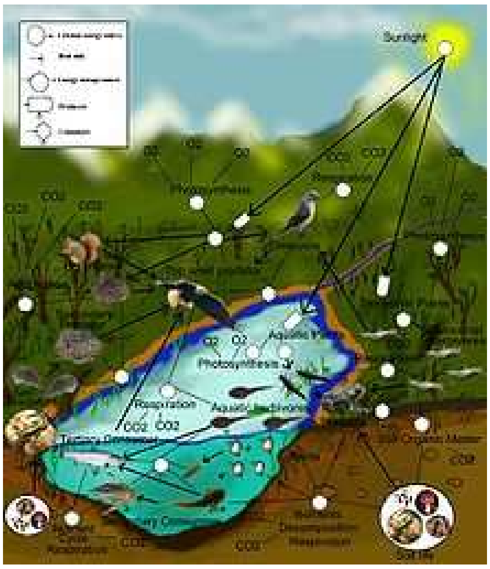
By the 19th century, ecology blossomed due to new discoveries in chemistry by Lavoisier and de Saussure, notably the nitrogen cycle. After observing the fact that life developed only within strict limits of each compartment that makes up the atmosphere, hydrosphere, and lithosphere, the Austrian geologist Eduard Suess proposed the term biosphere in 1875. Suess proposed the name biosphere for the conditions promoting life, such as those found on Earth, which includes flora, fauna, minerals, matter cycles, et cetera. In the 1920s Vladimir I. Vernadsky, a Russian geologist who had defected to France, detailed the idea of the biosphere in his work 'The biosphere' (1926), and described the fundamental principles of the biogeochemical cycles. He thus redefined the biosphere as the sum of all ecosystems. First ecological damages were reported in the 18th century, as the multiplication of colonies caused deforestation. Since the 19th century, with the industrial revolution, more and more pressing concerns have grown about the impact of human activity on the environment. The term ecologist has been in use since the end of the 19th century.

Community Ecology

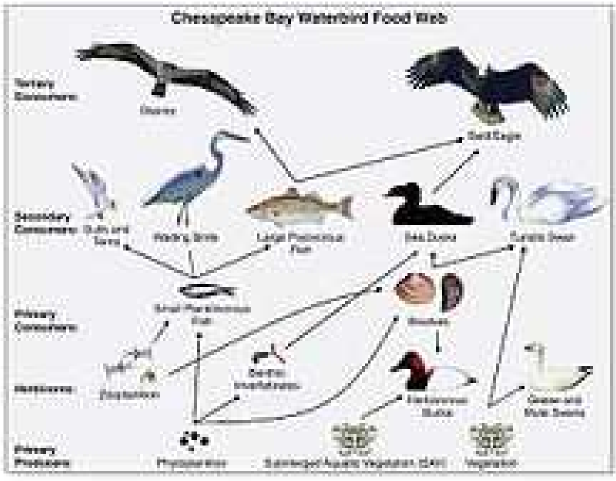
Community ecology examines how interactions among species and their environment affect the abundance, distribution and diversity of species within communities. Community ecology is a subdiscipline of ecology which studies the distribution, abundance, demography, and interactions between coexisting populations. An example of a study in community ecology might measure primary production in a wetland in relation to decomposition and consumption rates. This requires an understanding of the community connections between plants (i.e., primary producers) and the decomposers (e.g., fungi and bacteria). Food webs and trophic levels are two widely employed conceptual models used to explain the linkages among species.

Food Webs

A food web is the archetypal ecological network. They are a type of concept map that illustrate pathways of energy flows in an ecological community, usually starting with solar energy being used by plants during photosynthesis. As plants grow, they accumulate carbohydrates and are eaten by grazing herbivores. Step by step lines or relations are drawn until a web of life is illustrated.



Freshwater aquatic and terrestrial food webs



Generalized food web of water birds from Chesapeake Bay

There are different ecological dimensions that can be mapped to create more complicated food webs, including: species composition (type of species), richness (number of species), biomass (the dry weight of plants and animals), productivity (rates of conversion of energy and nutrients into growth), and stability (food webs over time). A food web diagram illustrating species composition shows how change in a single species can directly and indirectly influence many others. Microcosm studies are used to simplify food web research into semi-isolated units such as small springs, decaying logs, and laboratory experiments using organisms that reproduce quickly, such as daphnia feeding on algae grown under controlled environments in jars of water. Principles gleaned from food web microcosm studies are used to extrapolate smaller dynamic concepts to larger systems. Food webs are limited because they are generally restricted to a specific habitat, such as a cave or a pond. The food web illustration (right) only shows a small part of the complexity connecting the aquatic system to the adjacent terrestrial land. Many of these species migrate into other habitats to distribute their effects on a larger scale. In other words, food webs are incomplete, but are nonetheless a valuable tool in understanding community ecosystems. Food chain length is another way of describing food webs as a measure of the number of species encountered as energy or nutrients move from the plants to top predators. There are different ways of calculating food chain length depending on what parameters of the food web dynamic are being considered: connectance, energy, or interaction. In a simple predator-prey example, a deer is one step removed from the plants it eats (chain length = 1) and a wolf that eats the deer is two steps removed (chain length = 2). The relative amount or strength of influence that these parameters have on the food web address questions about:

- the identity or existence of a few dominant species (called strong interactors or keystone species)
- the total number of species and food chain length (including many weak interactors)
- community structure

Trophic Dynamics

The Greek root of the word *troph*, τροφή, trophē, means food or feeding. Links in food webs primarily connect feeding relations or trophism among species. Biodiversity within ecosystems can be organized into vertical and horizontal dimensions. The vertical dimension represents feeding relations that become further removed from the base of the food chain up toward top predators. The horizontal dimension represents the abundance or biomass at each level. When the relative abundance or biomass of each functional feeding group is stacked into their respective trophic levels they naturally sort into a ‘pyramid of numbers’. Functional groups are broadly categorized as autotrophs (or primary producers), heterotrophs (or consumers), and detritivores (or decomposers). Heterotrophs can be further sub-divided into different functional groups, including: primary consumers (strict herbivores), secondary consumers (predators that feed exclusively on herbivores) and tertiary consumers (predators that feed on a mix of herbivores and predators). Omnivores do not fit neatly into a functional category because they eat both plant and animal tissues. It has been suggested that omnivores have a greater functional influence as predators because relative to herbivores they are comparatively inefficient at grazing. Ecologists collect data on trophic levels and food webs to statistically model and mathematically calculate parameters, such as those used in other kinds of network analysis (e.g., graph theory), to study emergent patterns and properties shared among ecosystems. The size of each level in the pyramid generally represents biomass, which can be measured as the dry weight of an organism. Autotrophs may have the highest global proportion of biomass, but they are closely rivaled or surpassed by microbes.

The decomposition of dead organic matter, such as leaves falling on the forest floor, turns into soils that feed plant production. The total sum of the planet's soil ecosystems is called the pedosphere where a very large proportion of the Earth's biodiversity sorts into other trophic levels. Invertebrates that feed and shred larger leaves, for example, create smaller bits for smaller organisms in the feeding chain. Collectively, these are the detritivores that regulate soil formation. Tree roots, fungi, bacteria, worms, ants, beetles, centipedes, spiders, mammals, birds, reptiles, amphibians and other less familiar creatures all work to create the trophic web of life in soil ecosystems. As organisms feed and migrate through soils they physically displace materials, which is an important ecological process called bioturbation. Biomass of soil microorganisms are influenced by and feed back into the trophic dynamics of the exposed solar surface ecology. Paleoecological studies of soils place the origin for bioturbation to a time before the Cambrian period. Other events, such as the evolution of trees and amphibians moving into land in the Devonian period played a significant role in the development of soils and ecological trophism.

TEST 3

Part B

STRUCTURE AND WRITTEN EXPRESSION

Directions: In this part each problem consists of an incomplete sentence. Below the sentence are four choices marked (A), (B), (C), and (D). You should find the one choice which best completes the sentence.

1. … Greek root of the word *troph*, τροφή, trophē, means food or feeding.
(A) A
(B) An
(C) The
(D) –

2. There are different ways of calculating food chain length depending … what parameters of the food web dynamic are being considered: connectance, energy, or interaction.
(A) on
(B) into

(C) in
(D) to
3. However, Darwin never used the word in his writings after this year, not even in his most ‘ecological’ writings … the foreword to the English edition of Hermann Müller’s *The Fertilization of Flowers* (1883) or in his own treatise of earthworms and mull formation in forest soils (The formation of vegetable mould through the action of worms, 1881).
(A) as such
(B) and such
(C) such and such
(D) such as
4. Biomass of soil microorganisms are influenced … and feed back into the trophic dynamics of the exposed solar surface ecology.
(A) for
(B) beyond
(C) with
(D) by
5. The total sum of the planet’s soil ecosystems … the pedosphere where a very large proportion of the Earth’s biodiversity sorts into other trophic levels.
(A) is called
(B) is being called
(C) was being called
(D) has been called
6. Ecologists collect data on trophic levels and food webs to statistically model and mathematically calculate parameters, such as those … in other kinds of network analysis (e.g., graph theory), to study emergent patterns and properties shared among ecosystems.
(A) use
(B) used
(C) uses
(D) using
7. An example of a study in community ecology … measure primary production in a wetland in relation to decomposition and consumption rates.
(A) should
(B) shall
(C) may
(D) might

8. Microcosm studies are used to simplify food web research into semi-isolated units such as small springs, decaying logs, and laboratory experiments using organisms that reproduce quickly, such as daphnia feeding on algae grown under controlled environments in … of water.
(A) jugs
(B) pits
(C) pails
(D) jars
9. … most portrayals of Darwin conveying him as a non-aggressive recluse who let others fight his battles, Darwin remained all his life a man nearly obsessed with the ideas of competition, struggle and conquest – with all forms of human contact as confrontation.
(A) Despite
(B) In spite of
(C) Notwithstanding
(D) In spite of everything
10. After observing the fact that life developed only within strict limits of each compartment that makes up the atmosphere, hydrosphere, and lithosphere, the … geologist Eduard Suess proposed the term biosphere in 1875.
(A) Welsh
(B) Austrian
(C) English
(D) German

Part A **TEXT 4**

The Ecosystem: Arthur Tansley

Read and translate the text using a dictionary

Over the 19th century, botanical geography and zoogeography combined to form the basis of biogeography. This science, which deals with habitats of species, seeks to explain the reasons for the presence of certain species in a given location. It was in 1935 that Arthur Tansley, the British ecologist, coined the term ecosystem, the interactive system established between the biocoenosis (the group of living creatures), and their biotope, the environment in which they live. Ecology thus became the science of ecosystems.

Tansley's concept of the ecosystem was adopted by the energetic and influential biology educator Eugene Odum. Along with his brother, Howard Odum, Eugene P. Odum wrote a textbook which (starting in 1953) educated more than one generation of biologists and ecologists in North America.

Ecological Succession – Henry Chandler Cowles


The Indiana Dunes on Lake Michigan, which stimulated Cowles' development of his theories of ecological successio

At the turn of the 20th century, Henry Chandler Cowles was one of the founders of the emerging study of 'dynamic ecology', through his study of ecological succession at the Indiana Dunes, sand dunes at the southern end of Lake Michigan. Here Cowles found evidence of ecological succession in the vegetation and the soil with relation to age. Cowles was very much aware of the roots of the concept and of his (primordial) predecessors. Thus, he attributes the first use of the word to the French naturalist Adolphe Dureau de la Malle, who had described the vegetation development after forest clear-felling, and the first comprehensive study of successional processes to the Finnish botanist Ragnar Hult (1885).

The Biosphere

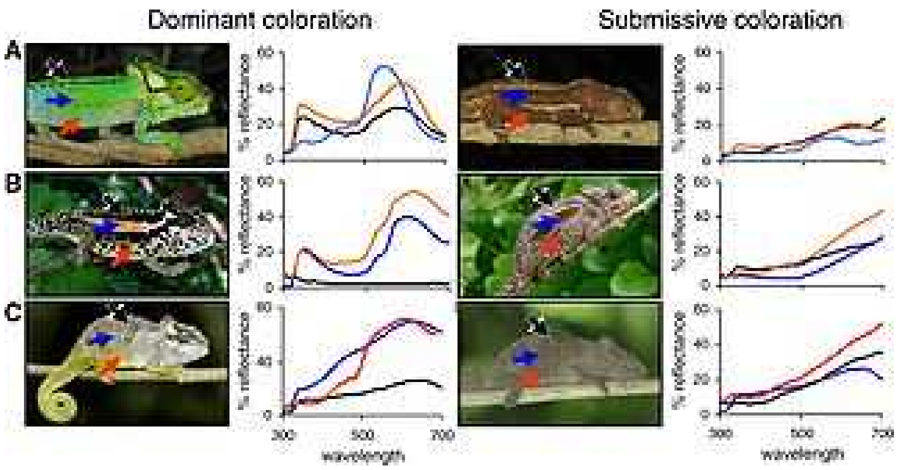
Ecological theory has been used to explain self-emergent regulatory phenomena at the planetary scale. The largest scale of ecological organization is the biosphere: the total sum of ecosystems on the planet. Ecological relations regulate the flux of energy, nutrients, and climate all the way up to the planetary scale. For example, the dynamic history of the planetary CO_2 and O_2 composition of the atmosphere has been largely determined by the biogenic flux of gases coming from respiration and photosynthesis, with levels fluctuating over time and in relation to the ecology and evolution of plants and animals. When sub-component parts are organized into a whole there are oftentimes emergent properties that describe the nature of the system. This Gaia hypothesis is an example of holism applied in ecological theory. The ecology of the planet acts as a single regulatory or holistic unit called Gaia. The Gaia hypothesis states that there is an emergent feedback loop generated by the metabolism of living organisms that maintains the temperature of the Earth and atmospheric conditions within a narrow self-regulating range of tolerance.

Relation to Evolution

Ecology and evolution are considered sister disciplines of the life sciences. Natural selection, life history, development, adaptation, populations, and inheritance are examples of concepts that thread equally into ecological and evolutionary theory. Morphological, behavioural and/or genetic traits, for example, can be mapped onto evolutionary trees to study the historical development of a species in relation to their functions and roles in different ecological circumstances.

In this framework, the analytical tools of ecologists and evolutionists overlap as they organize, classify and investigate life through common systematic principles, such as phylogenetics or the Linnaean system of taxonomy. The two disciplines often appear together, such as in the title of the journal *Trends in Ecology and Evolution*. There is no sharp boundary separating ecology from evolution and they differ more in their areas of applied focus. Both disciplines discover and explain emergent and unique properties and processes operating across different spatial or temporal scales of organization. While the boundary between ecology and evolution is not always clear, it is understood that ecologists study the abiotic and biotic factors that influence the evolutionary process.

Behavioural Ecology



Social display and colour variation in differently adapted species of chameleons (*Bradypodion* spp.).
Chameleons change their skin colour to match their background as a behavioural defense mechanism and also use colour to communicate with other members of their species, such as dominant (left) versus submissive (right) patterns shown in the three species (A - C) above. All organisms are motile to some extent. Even plants express complex behaviour, including memory and communication.
Behavioural ecology is the study of ethology and its ecological and evolutionary implications. Ethology is the study of observable movement or behaviour in nature. This could include investigations of motile sperm of plants, mobile phytoplankton, zooplankton swimming toward the female egg, the cultivation of fungi by weevils, the mating dance of a salamander, or social gatherings of ameba. Adaptation is the central unifying concept in behavioural ecology. Behaviours can be recorded as traits and inherited in much the same way that eye and hair colour can. Behaviours evolve and become adapted to the ecosystem because they are subject to the forces of natural selection. Hence, behaviours can be adaptive, meaning that they evolve functional utilities that increase reproductive success for the individuals that inherit such traits. This is also the technical definition for fitness in biology, which is a measure of reproductive success over successive generations. Predator-prey interactions are an introductory concept into food web studies as well as behavioural ecology. Prey species can exhibit different kinds of behavioural adaptations to predators, such as avoid, flee or defend. Many prey species are faced with multiple predators that differ in the degree of danger posed. To be adapted to their environment and face predatory threats, organisms must balance their energy budgets as they invest in different aspects of their life history, such as growth, feeding, mating, socializing, or modifying their habitat. Hypotheses posited in behavioural ecology are generally based on adaptive principles of conservation, optimization or efficiency. For example, ‘the threat-sensitive predator avoidance

hypothesis predicts that prey should assess the degree of threat posed by different predators and match their behaviour according to current levels of risk.' 'The optimal flight initiation distance occurs where expected postencounter fitness is maximized, which depends on the prey's initial fitness, benefits obtainable by not fleeing, energetic escape costs, and expected fitness loss due to predation risk.' The behaviour of long-toed salamanders (*Ambystoma macrodactylum*) presents an example in this context. When threatened, the long-toed salamander defends itself by waving its tail and secreting a white milky fluid. The excreted fluid is distasteful, toxic and adhesive, but it is also used for nutrient and energy storage during hibernation. Hence, salamanders subjected to frequent predatory attack will be energetically compromised as they use up their energy stores.

Symbiosis: Leafhoppers (*Eurymela fenestrata*) are protected by ants (*Iridomyrmex purpureus*) in a symbiotic relationship. The ants protect the leafhoppers from predators and in return the leafhoppers feeding on plants exude honeydew from their anus that provides energy and nutrients to tending ants. Ecological interactions can be divided into host and associate relationships. A host is any entity that harbours another that is called the associate. Host and associate relationships among species that are mutually or reciprocally beneficial are called mutualisms. If the host and associate are physically connected, the relationship is called symbiosis. Approximately 60% of all plants, for example, have a symbiotic relationship with arbuscular mycorrhizal fungi. Symbiotic plants and fungi exchange carbohydrates for mineral nutrients. Symbiosis differs from indirect mutualisms where the organisms live apart. For example, tropical rain forests regulate the Earth's atmosphere. Trees living in the equatorial regions of the planet supply oxygen into the atmosphere that sustains species living in distant polar regions of the planet. This relationship is called commensalism because many other host species receive the benefits of clean air at no cost or harm to the associate tree species supplying the oxygen. The host and associate relationship is called parasitism if one species benefits while the other suffers. Competition among species or among members of the same species is defined as reciprocal antagonism, such as grasses competing for growth space.

Parasites: *A harvestman arachnid is parasitized by mites. This is parasitism because the harvestman is being consumed as its juices are slowly sucked out while the mites gain all the benefits travelling on and feeding off of their host.This parasitism may cause the harvestman suffering.*

Popular ecological study systems for mutualism include, fungus-growing ants employing agricultural symbiosis, bacteria living in the guts of insects and other organisms, the fig wasp and yucca moth pollination complex, lichens with fungi and photosynthetic algae, and corals with photosynthetic algae. Intraspecific behaviours are notable in the social insects, slime moulds, social spiders, human society, and naked mole rats where eusocialism has evolved. Social behaviours include reciprocally beneficial behaviours among kin and nest mates. Social behaviours evolve from kin and group selection. Kin selection explains altruism through genetic relationships, whereby an altruistic behaviour leading to death is rewarded by the survival of genetic copies distributed among surviving relatives. The social insects, including ants, bees and wasps are most famously studied for this type of relationship because the male drones are clones that share the same genetic make-up as every other male in the colony. In contrast, group selectionists find examples of altruism among non-genetic relatives and explain this through selection acting on the group, whereby it becomes selectively advantageous for groups if their members express altruistic behaviours to one another. Groups that are predominantely altruists beat groups that are predominantely selfish. An often quoted behavioural ecology hypothesis is known as Lack’s brood reduction hypothesis (named after David Lack). Lack’s hypothesis posits an evolutionary and ecological explanation as to why birds lay a series of eggs with an asynchronous delay leading to nestlings of mixed age and weights. According to Lack, this brood behaviour is an ecological insurance that allows the larger birds to survive in poor years and all birds to survive when food is plentiful.

Elaborate sexual displays and posturing are encountered in the behavioural ecology of animals. The birds of paradise, for example, display elaborate ornaments and song during courtship. These displays serve a dual purpose of signalling healthy or well-adapted individuals and good genes. The elaborate displays are driven by sexual selection as an advertisement of quality of traits among male suitors.

Biogeography

The word *biogeography* is an amalgamation of *biology* and *geography*. Biogeography is the comparative study of the geographic distribution of organisms and the corresponding evolution of their traits in space and time. The Journal of Biogeography was established in 1974. Biogeography and ecology share many of their disciplinary roots. For example, the theory of island biogeography, published by the mathematician Robert MacArthur and ecologist Edward O. Wilson in 1967 is considered one of the fundamentals of ecological theory. Biogeography has a long history in the natural sciences where questions arise concerning the spatial distribution.

TEST 4

Part B

STRUCTURE AND WRITTEN EXPRESSION

Directions: In this part each problem consists of an incomplete sentence. Below the sentence are four choices marked (A), (B), (C), and (D). You should find the one choice which best completes the sentence.

1. The social insects, including ants, bees and wasps are most famously studied for this type of relationship because the male drones are clones that share the same genetic … as every other male in the colony.

(A) make for

(B) make after

(C) make-up

(D) make with

2. The birds of paradise, …, display elaborate ornaments and song during courtship.

(A) in fact

(B) for a fact

(C) for example

(D) in actual fact

3. It … in 1935 that Arthur Tansley, the British ecologist, coined the term ecosystem, the interactive system established between the biocoenosis (the group of living creatures), and their biotope, the environment in which they live.

(A) were

(B) was

(C) is

(D) be

4. Ecology and evolution … sister disciplines of the life sciences.

(A) are being considered

(B) were being considered

(C) are considered

(D) is considered

5. Approximately … of all plants, for example, have a symbiotic relationship with arbuscular mycorrhizal fungi.

(A) 30 per cent

(B) 40 per cent

(C) 50 per cent

(D) 60 per cent

6. … to their environment and face predatory threats, organisms must balance their energy budgets as they invest in different aspects of their life history, such as growth, feeding, mating, socializing, or modifying their habitat.

(A) To have been adapted

(B) To have been adapting

(C) To have adapted

(D) To be adapted

7. For example, the dynamic history of the planetary CO_2 and O_2 composition of the atmosphere … by the biogenic flux of gases coming from respiration and photosynthesis, with levels fluctuating over time and in relation to the ecology and evolution of plants and animals.

(A) had been largely determined

(B) has been largely determined

(C) have been largely determined

(D) would have been largely determined

8. Chameleons change their skin colour to match their background as a behavioural defense mechanism and also use colour to communicate with other members of their species, such as dominant (left) versus submissive (right) … shown in the three species (A-C) above.

(A) patterns
(B) models
(C) samples
(D) systems

9. At the turn of the 20th century, Henry Chandler Cowles was one of the founders of the emerging study of ‘dynamic ecology’, … his study of ecological succession at the Indiana Dunes, sand dunes at the southern end of Lake Michigan.

(A) at
(B) in
(C) through
(D) with

10. … could include investigations of motile sperm of plants, mobile phytoplankton, zooplankton swimming toward the female egg, the cultivation of fungi by weevils, the mating dance of a salamander, or social gatherings of ameba.

(A) That
(B) Those
(C) This
(D) These

Part A **TEXT 5**

Human Ecology

Read and translate the text using a dictionary

Human ecology began in the 1920s, through the study of changes in vegetation succession in the city of Chicago. It became a distinct field of study in the 1970s. This marked the first recognition that humans, who had colonized all of the Earth’s continents, were a major ecological factor. Humans greatly modify the environment through the development of the habitat (in particular urban planning), by intensive exploitation activities such as logging and fishing, and as side effects of agriculture, mining, and industry. Besides ecology and biology, this discipline involved many other natural and social sciences, such as anthropology and ethnology, economics, demography, architecture and urban planning, medicine and psychology, and many more. The development of human ecology led to the increasing role of ecological science in the design and management of cities. In recent years human ecology has been a topic that has interested organizational researchers. Hannan and Freeman (*Population Ecology of Organizations (1977)*, American Journal of Sociology) argue that organizations do not only adapt to an environment. Instead it is also the environment that selects or rejects populations of organizations. In any given environment (in equilibrium) there will only be one form of organization (isomorphism). Organizational ecology has been a prominent theory in accounting for diversities of organizations and their changing composition over time.

James Lovelock and the Gaia Hypothesis

The Gaia theory, proposed by James Lovelock, in his work *Gaia: New Look at Life on Earth*, advanced the view that the Earth should be regarded as a single living macroorganism. In particular, it argued that the ensemble of living organisms has jointly evolved an ability to control the global environment – by influencing major physical parameters as the composition of the atmosphere, the evaporation rate, the chemistry of soils and oceans – so as to maintain conditions favourable to life. This vision was largely a sign of the times, in particular the growing perception after the Second World War that human activities such as nuclear energy, industrialization, pollution, and overexploitation of natural resources, fuelled by exponential population growth, were threatening to create catastrophes on a planetary scale. Thus Lovelock's Gaia hypothesis, while controversial among scientists, was embraced by many environmental movements as an inspiring view: their *Earth-mother*, Gaia, was 'becoming sick from humans and their activities'.

Population Ecology

The population is the unit of analysis in population ecology. A population consists of individuals of the same species that live, interact and migrate through the same niche and habitat. A primary law of population ecology is the Malthusian growth model. This law states that: '...a population will grow (or decline) exponentially as long as the environment experienced by all individuals in the population remains constant'. This Malthusian premise provides the basis for formulating predictive theories and tests that follow. Simplified population models usually start with four variables including death, birth, immigration, and emigration. Mathematical models are used to calculate changes in population demographics using a null model. A null model is used as a null hypothesis for statistical testing. The null hypothesis states that random processes create observed patterns. Alternatively the patterns differ significantly from the random model and require further explanation. Models can be mathematically complex where '...several competing hypotheses are simultaneously confronted with the data'. An example of an introductory population model describes a closed population, such as on an island, where immigration and emigration do not take place. In these island models the rate of population change is described by:

$$\frac{dN}{dT} = B - D = bN - dN = (b - d)N = rN,$$

where *N* is the total number of individuals in the population, *B* is the number of births, *D* is the number of deaths, *b* and *d* are the per capita rates of birth and death respectively, and *r* is the per capita rate of population change. This formula can be read out as the rate of change in the population (*dN/dT*) is equal to births minus deaths (B – D).

Using these modelling techniques, Malthus' population principle of growth was later transformed into a model known as the logistic equation:

$$\frac{dN}{dT} = aN(1 - \frac{N}{K}),$$

where *N* is the number of individuals measured as biomass density, *a* is the maximum per-capita rate of change, and *K* is the carrying capacity of the population. The formula can be read as follows: the rate of change in the population (*dN/dT*) is equal to growth (*aN*) that is limited by carrying capacity *(1 – N/K)*. The discipline of population ecology builds upon these introductory models to further understand demographic processes in real study populations and conduct statistical tests. The field of population ecology often uses data on life history and matrix algebra to develop projection matrices on fecundity and survivorship. This information is used for managing wildlife stocks and setting harvest quotas.

Metapopulation Ecology

Populations are also studied and modelled according to the metapopulation concept. The metapopulation concept was introduced in 1969: 'as a population of populations which go extinct locally and recolonize'. Metapopulation ecology is another statistical approach that is often used in conservation research. Metapopulation research simplifies the landscape into patches of varying levels of quality. Metapopulation models have been used to explain life-history evolution, such as the ecological stability of amphibian metamorphosis in small vernal ponds. Alternative ecological strategies have evolved. For example, some salamanders forgo metamorphosis and sexually mature as aquatic neotenes. The seasonal duration of wetlands and the migratory range of the species point out which ponds are connected and if they form a metapopulation. The duration of the life history stages of amphibians relative to the duration of the vernal pool before it dries up regulates the ecological development of metapopulations connecting aquatic patches to terrestrial patches.

In metapopulation terminology there are emigrants (individuals that leave a patch), immigrants (individuals that move into a patch) and sites are classed either as sources or sinks. A site is a generic term that refers to places where ecologists sample populations, such as ponds or defined sampling areas in a forest. Source patches are productive sites that generate a seasonal supply of juveniles that migrate to other patch locations. Sink patches are unproductive sites that only receive migrants and will go extinct unless rescued by an adjacent source patch or environmental conditions become more favourable. Metapopulation models examine patch dynamics over time to answer questions about spatial and demographic ecology. The ecology of metapopulations is a dynamic process of extinction and colonization. Small patches of lower quality (i.e., sinks) are maintained or rescued by a seasonal influx of new immigrants. A dynamic metapopulation structure evolves from year to year, where some patches are sinks in dry years and become sources when conditions are more favourable. Ecologists use a mixture of computer models and field studies to explain metapopulation structure.

Molecular Ecology

The important relationship between ecology and genetic inheritance predates modern techniques for molecular analysis. Molecular ecological research became more feasible with the development of rapid and accessible genetic technologies, such as the polymerase chain reaction (PCR). The rise of molecular technologies and influx of research questions into this new ecological field resulted in the publication *Molecular Ecology* in 1992. Molecular ecology uses various analytical techniques to study genes in an evolutionary and ecological context. In 1994, Professor John Avise also played a leading role in this area of science with the publication of his book, *Molecular Markers, Natural History and Evolution*. Newer technologies opened a wave of genetic analysis into organisms once difficult to study from an ecological or evolutionary standpoint, such as bacteria, fungi and nematodes.

Molecular ecology engendered a new research paradigm to investigate ecological questions considered otherwise intractable. Molecular investigations revealed previously obscured details in the tiny intricacies of nature and improved resolution into probing questions about behavioural and biogeographical ecology. For example, molecular ecology revealed promiscuous sexual behaviour and multiple male partners in tree swallows previously thought to be socially monogamous. In a biogeographical context, the marriage between genetics, ecology and evolution resulted in a new sub-discipline called phylogeography.

Relation to the Environment

The environment is dynamically interlinked, imposed upon and constrains organisms at any time throughout their life cycle. Like the term ecology, environment has different conceptual meanings and to many these terms also overlap with the concept of *nature*. Environment '... includes the physical world, the social world of human relations and the built world of human creation'. The environment in ecosystems includes both physical parameters and biotic attributes. The physical environment is external to the level of biological organization under investigation, including abiotic factors such as temperature, radiation, light, chemistry, climate and geology. The biotic environment includes genes, cells, organisms, members of the same species (conspecifics) and other species that share a habitat. Armed with an understanding of metabolic and thermodynamic principles a complete accounting of energy and material flow can be traced through an ecosystem.

Environmental and ecological relations are studied through reference to conceptually manageable and isolated parts. Once the effective environmental components are understood they conceptually link back together as a *holocoenotic* system. In other words, the organism and the environment form a dynamic whole (or umwelt). Change in one ecological or environmental factor can concurrently affect the dynamic state of an entire ecosystem. Ecological studies are necessarily holistic as opposed to reductionistic. Holism has three scientific meanings or uses that identify with: 1) the mechanistic complexity of ecosystems, 2) the practical description of patterns in quantitative reductionist terms where correlations may be identified but nothing is understood about the causal relations without reference to the whole system, which leads to 3) a metaphysical hierarchy whereby the causal relations of larger systems are understood without reference to the smaller parts. An example of the metaphysical aspect to holism is the trend of increased exterior thickness in shells of different species. The reason for a thickness increase can be understood through reference to principles of natural selection via predation without any reference to the biomolecular properties of the exterior shells.

Metabolism and the Early Atmosphere

Metabolism – the rate at which energy and material resources are taken up from the environment, transformed within an organism, and allocated to maintenance, growth and reproduction – is a fundamental physiological trait. The Earth formed approximately 4.5 billion years ago and environmental conditions were too extreme for life to form for the first 500 million years.

During this early Hadean period, the Earth started to cool, allowing a crust and oceans to form. Environmental conditions were unsuitable for the origins of life for the first billion years after the Earth formed. The Earth's atmosphere transformed from being dominated by hydrogen, to one composed mostly of methane and ammonia. Over the next billion years the metabolic activity of life transformed the atmosphere to higher concentrations of carbon dioxide, nitrogen, and water vapour. These gases changed the way that light from the Sun hit the Earth's surface and greenhouse effects trapped heat. There were untapped sources of free energy within the mixture of reducing and oxidizing gasses that set the stage for primitive ecosystems to evolve and, in turn, the atmosphere also evolved.


The leaf is the primary site of photosynthesis in most plants.

Throughout history, the Earth's atmosphere and biogeochemical cycles have been in a dynamic equilibrium with planetary ecosystems. The history is characterized by periods of significant transformation followed by millions of years of stability. The evolution of the earliest organisms, likely anaerobic methanogen microbes, started the process by converting atmospheric hydrogen into methane ($4H_2 + CO_2 \rightarrow CH_4 + 2H_2O$). Anoxygenic photosynthesis converting hydrogen sulfide into other sulfur compounds or water ($2H_2S + CO_2 \rightarrow h\nu \rightarrow CH_2O \rightarrow H_2O \rightarrow + 2S$ or $2H_2 + CO_2 +$

hν → CH_2O + H_2O), as occurs in deep sea hydrothermal vents today, reduced hydrogen concentrations and increased atmospheric methane. Early forms of fermentation also increased levels of atmospheric methane. The transition to an oxygen dominant atmosphere (the *Great Oxidation*) did not begin until approximately 2.4-2.3 billion years ago, but photosynthetic processes started 0.3 to 1 billion years prior.

Radiation: Heat, Temperature and Light

The biology of life operates within a certain range of temperatures. Heat is a form of energy that regulates temperature. Heat affects growth rates, activity, behaviour and primary production. Temperature is largely dependent on the incidence of solar radiation. The latitudinal and longitudinal spatial variation of temperature greatly affects climates and consequently the distribution of biodiversity and levels of primary production in different ecosystems or biomes across the planet. Heat and temperature relate importantly to metabolic activity. Poikilotherms, for example, have a body temperature that is largely regulated and dependent on the temperature of the external environment. In contrast, homeotherms regulate their internal body temperature by expending metabolic energy.

There is a relationship between light, primary production, and ecological energy budgets. Sunlight is the primary input of energy into the planet's ecosystems. Light is composed of electromagnetic energy of different wavelengths. Radiant energy from the Sun generates heat, provides photons of light measured as active energy in the chemical reactions of life, and also acts as a catalyst for genetic mutation. Plants, algae, and some bacteria absorb light and assimilate the energy through photosynthesis. Organisms capable of assimilating energy by photosynthesis or through inorganic fixation of H_2S are autotrophs. Autotrophs – responsible for primary production – assimilate light energy that becomes metabolically stored as potential energy in the form of biochemical enthalpic bonds.

TEST 5

Part B

STRUCTURE AND WRITTEN EXPRESSION

Directions: In this part each problem consists of an incomplete sentence. Below the sentence are four choices marked (A), (B), (C), and (D). You should find the

one choice which best completes the sentence.

1. Radiant energy from the Sun generates heat, provides photons of light measured as active energy in the chemical reactions of life, … also acts as a catalyst for genetic mutation.

(A) but

(B) or

(C) that

(D) and

2. The transition to an oxygen dominant atmosphere (the *Great Oxidation*) did not begin until approximately 2.4-2.3 billion years ago, but photosynthetic processes started 0.3 to 1 … years prior.

(A) million

(B) thousand

(C) hundred

(D) billion

3. Anoxygenic photosynthesis converting hydrogen sulfide into other sulfur compounds or water ($2H_2S + CO_2 \rightarrow h\nu \rightarrow CH_2O \rightarrow H_2O \rightarrow + 2S$ or $2H_2 + CO_2 + h\nu \rightarrow CH_2O + H_2O$), as occurs in deep sea hydrothermal vents …, reduced hydrogen concentrations and increased atmospheric methane.

(A) now

(B) yesterday

(C) today

(D) tomorrow

4. The rise of molecular technologies and influx of research questions into this new ecological field resulted … the publication *Molecular Ecology* in 1992.

(A) to

(B) with

(C) for

(D) in

5. A site is a generic … that refers to places where ecologists sample populations, such as ponds or defined sampling areas in a forest.

(A) idea

(B) notion

(C) term

(D) expression

6. …. population consists of individuals of the same species that live, interact and migrate through the same niche and habitat.

(A) A
(B) The
(C) An
(D) –

7. Humans greatly modify the environment through the development of the habitat (in particular urban planning), by intensive exploitation … such as logging and fishing, and as side effects of agriculture, mining, and industry.
(A) activities
(B) work
(C) operation
(D) functioning

8. Holism has three scientific meanings or uses that identify with: 1) the mechanistic complexity of ecosystems, 2) the practical description of patterns in quantitative reductionist terms where correlations may be identified but nothing is understood about the causal relations without reference to the whole system, which leads to 3) a metaphysical hierarchy … the causal relations of larger systems are understood without reference to the smaller parts.
(A) whereas
(B) whereof
(C) wherefore
(D) whereby

9. Besides ecology and biology, this discipline involved many other natural and social sciences, such as anthropology and ethnology, economics, demography, architecture and urban planning, medicine and …, and many more.
(A) physics
(B) physiotherapy
(C) psychology
(D) physiology

10. …, it argued that the ensemble of living organisms has jointly evolved an ability to control the global environment – by influencing major physical parameters as the composition of the atmosphere, the evaporation rate, the chemistry of soils and oceans – so as to maintain conditions favourable to life.
(A) In particular
(B) Every other day
(C) In other words
(D) Sometime or other

Part A **TEXT 6**

Conservation and Environmental Movements

Read and translate the text using a dictionary

Environmentalists and other conservationists have used ecology and other sciences (e.g., climatology) to support their advocacy positions. Environmentalist views are often controversial for political or economic reasons. As a result, some scientific work in ecology directly influences policy and political debate; these in turn often direct ecological research. The history of ecology, however, should not be conflated with that of environmental thought. Ecology as a modern science traces only from Darwin’s publication of Origin of Species and Haeckel’s subsequent naming of the science needed to study Darwin’s theory. Awareness of humankind’s effect on its environment has been traced to Gilbert White in the 18th-century Selborne, England. Awareness of nature and its interactions can be traced back even farther in time. Ecology before Darwin, however, is analogous to medicine prior to Pasteur’s discovery of the infectious nature of disease. The history is there, but it is only partly relevant. Neither Darwin nor Haeckel, it is true, did self-avowed ecological studies. The same can be said for researchers in a number of fields who contributed to ecological thought well into the 1940s without avowedly being ecologists. Raymond Pearl’s population studies are a case in point. Ecology in subject matter and techniques grew out of studies by botanists and plant geographers in the late 19th and early 20th centuries that paradoxically lacked Darwinian evolutionary perspectives. Until Mendel’s studies with peas were rediscovered and melded into the Modern Synthesis, Darwinism suffered in credibility. Many early plant ecologists had a Lamarckian view of inheritance, as did Darwin, at times. When the Ecological Society of America (ESA) was chartered in 1915, it already had a conservation perspective. Victor E. Shelford, a leader in the society’s formation, had as one of its goals the preservation of the natural areas that were then the objects of study by ecologists, but were in danger of being degraded by human incursion. Human ecology had also been a visible part of the ESA at its inception, as evident by publications such as: ‘The Control of Pneumonia and Influenza by the Weather’, ‘An Overlook of the Relations of Dust to Humanity’, ‘The Ecological Relations of the Polar Eskimo’, and ‘City Street Dust and Infectious Diseases’, in early pages of Ecology and Ecological Monographs. The ESA’s second president Ellsworth Huntington was a human ecologist. Stephen Forbes, another early president, called for ‘humanizing’ ecology in 1921, since man was clearly the dominant species on the Earth. This auspicious start actually was the first of a series of fitful progressions and reversions by the new science with regard to conservation. Human ecology necessarily focused on man-influenced environments and their practical problems. Ecologists in general, however, were trying to establish ecology as a basic science, one with enough prestige to make inroads into Ivy League faculties. Disturbed environments, it was thought, would not reveal nature’s secrets. Interest in the environment created by the American Dust Bowl produced a flurry of calls in 1935 for ecology to take a look at practical issues. Pioneering ecologist C. C. Adams wanted to return human ecology to the science. Frederic E. Clements, the dominant plant ecologist of the day, reviewed land use issues leading to the Dust Bowl in terms of his ideas on plant succession and climax. Paul Sears reached a wide audience with his book, *Deserts on the March*. World War II, perhaps, caused the issue to be put aside. The tension between pure ecology, seeking to understand and explain, and applied ecology, seeking to describe and repair, came to a head after World War II. Adams again tried to push the ESA into applied areas by having it raise an endowment to promote ecology. He predicted that ‘a great expansion of ecology’ was imminent ‘because of its integrating tendency’. Ecologists, however, were sensitive to the perception that ecology was still not considered a rigorous, quantitative science. Those who pushed for applied studies and active involvement in conservation were once more discretely rebuffed. Human ecology became subsumed by sociology. It was sociologist Lewis Mumford who brought the ideas of George Perkins Marsh to modern attention in the 1955 conference, ‘Man’s Role in Changing the Face of the Earth’. That prestigious conclave was dominated by social scientists. At it, ecology was accused of ‘lacking experimental methods’ and neglecting ‘man as an ecological agent’. One participant dismissed ecology as ‘archaic and sterile’. Within the ESA, a frustrated Shelford started the Ecologists’ Union when his Committee on Preservation of Natural Conditions ceased to function due to the political infighting over the ESA stance on conservation. In 1950, the fledgling organization was renamed and incorporated as the Nature Conservancy, a name borrowed from the British government agency for the same purpose. Two events, however, led to changes in ecology’s course away from applied problems. One was the Manhattan Project. It had become the Nuclear Energy Commission after the war. It is now the Department of Energy (DOE). Its ample budget included studies of the impacts of nuclear weapon use and production. That brought ecology to the issue, and it made a ‘Big Science’ of it. Ecosystem science, both basic and applied, began to compete with theoretical ecology (then called evolutionary ecology and also mathematical ecology). Eugene Odum, who published a very popular ecology textbook in 1953, became the champion of the ecosystem. In his publications, Odum called for ecology to have an ecosystem and applied focus. The second event was the publication of Silent Spring. Rachel Carson's book brought ecology as a word and concept to the public. Her influence was instant. A study committee, prodded by the publication of the book, reported to the ESA that their science was not ready to take on the responsibility being given to it. Carson's concept of ecology was very much that of Gene Odum. As a result, ecosystem science dominated the International Biological Programme of the 1960s and 1970s, bringing both money and prestige to ecology. Silent Spring was also the impetus for the environmental protection programmes that were started in the Kennedy and Johnson administrations and passed into law just before the first Earth Day. Ecologists' input was welcomed. Former ESA President Stanley Cain, for example, was appointed an Assistant Secretary in the Department of the Interior. A prominent Canadian ecologist declared it a 'boondoggle'. NEPA and similar state statutes, if nothing else, provided much employment for ecologists. Therein was the issue. Neither ecology nor ecologists were ready for the task. Not enough ecologists were available to work on impact assessment, outside of the DOE laboratories, leading to the rise of 'instant ecologists', having dubious credentials and capabilities. Calls began to arise for the professionalization of ecology. Maverick scientist Frank Egler, in particular, devoted his sharp prose to the task.

Physical Environments

Water

Wetland conditions such as shallow water, high plant productivity, and anaerobic substrates provide a suitable environment for important physical, biological, and chemical processes. Because of these processes, wetlands play a vital role in global nutrient and element cycles. The rate of diffusion of carbon dioxide and oxygen is approximately 10,000 times slower in water than it is in air. When soils become flooded, they quickly lose oxygen from low-concentration (hypoxic) to an (anoxic) environment where anaerobic bacteria thrive among the roots. Water also influences the spectral properties of light that becomes more diffuse as it is reflected off the water surface and submerged particles. Aquatic plants exhibit a wide variety of morphological and physiological adaptations that allow them to survive, compete and diversify these environments. For example, the roots and stems develop large cellular air spaces to allow for the efficient transportation gases (for example, CO_2 and O_2) used in respiration and photosynthesis. In drained soil, microorganisms use oxygen during respiration. In aquatic environments, anaerobic soil microorganisms use nitrate, manganic ions, ferric ions, sulfate, carbon dioxide and some organic compounds. The activity of soil microorganisms and the chemistry of the water reduce the oxidation-reduction potentials of the water. Carbon dioxide, for example, is reduced to methane (CH_4) by methanogenic bacteria. Salt water also requires special physiological adaptations to deal with water loss. Salt water plants (or halophytes) are able to osmo-regulate their internal salt (NaCl) concentrations or develop special organs for shedding salt away. The physiology of fish is also specially adapted to deal with high levels of salt through osmoregulation. Their gills form electrochemical gradients that mediate salt excrusion in salt water and uptake in fresh water.

Gravity

The shape and energy of the land is affected to a large degree by gravitational forces. On a larger scale, the distribution of gravitational forces on the Earth are uneven and influence the shape and movement of tectonic plates as well as having an influence on geomorphic processes such as orogeny and erosion. These forces govern many of the geophysical properties and distributions of ecological biomes across the Earth. On an organism scale, gravitational forces provide directional cues for plant and fungal growth (gravitropism), orientation cues for animal migrations, and influence the biomechanics and size of animals. Ecological traits, such as allocation of biomass in trees during growth are subject to mechanical failure as gravitational forces influence the position and structure of branches and leaves. The cardiovascular systems of all animals are functionally adapted to overcome pressure and gravitational forces that change according to the features of organisms (e.g., height, size, shape), their behaviour (e.g., diving, running, flying), and the habitat occupied (e.g., water, hot deserts, cold tundra).

Pressure

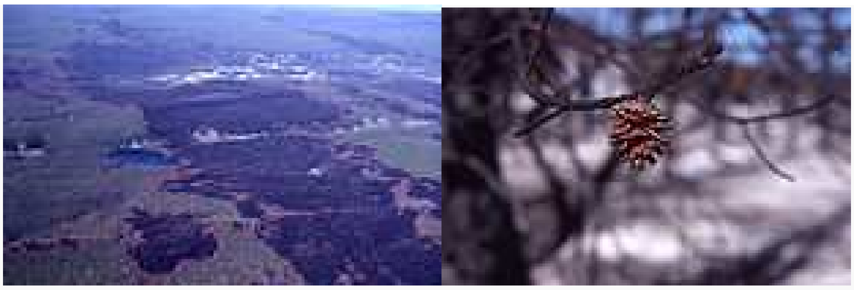
Climatic and osmotic pressure places physiological constraints on organisms, such as flight and respiration at high altitudes, or diving to deep ocean depths. These constraints influence vertical limits of ecosystems in the biosphere as organisms are physiologically sensitive and adapted to atmospheric and osmotic water pressure differences. Oxygen levels, for example, decrease with increasing pressure and are a limiting factor for life at higher altitudes. Water transportation through trees is another important ecophysiological parameter dependent upon pressure. Water pressure in the depths of oceans requires adaptations to deal with the different living conditions. Mammals, such as whales, dolphins and seals are adapted to deal with changes in sound due to water pressure differences.

Wind and Turbulence

The architecture of inflorescence in grasses is subject to the physical pressure of wind and shaped by the forces of natural selection facilitating wind-pollination (or anemophily).

Turbulent forces in air and water have significant effects on the environment and ecosystem distribution, form and dynamics. Turbulent forces in air and water have significant effects on the environment and ecosystem distribution, form and dynamics. On a planetary scale, ecosystems are affected by circulation patterns in the global trade winds. Wind power and the turbulent forces it creates can influence heat, nutrient, and biochemical profiles of ecosystems. For example, wind running over the surface of a lake creates turbulence, mixing the water column and influencing the environmental profile to create thermally layered zones, partially governing how fish, algae, and other parts of the aquatic ecology are structured. Wind speed and turbulence also exert influence on rates of evapotranspiration rates and energy budgets in plants and animals. Wind speed, temperature and moisture content can vary as winds travel across different land features and elevations. The westerlies, for example, come into contact with the coastal and interior mountains of western North America to produce a rain shadow on the leeward side of the mountain. The air expands and moisture condenses as the winds move up in elevation which can cause precipitation; this is called orographic lift. This environmental process produces spatial divisions in biodiversity, as species adapted to wetter conditions are range-restricted to the coastal mountain valleys and unable to migrate across the xeric ecosystems of the Columbia Basin to intermix with sister lineages that are segregated to the interior mountain systems.

Fire



Forest fires modify the land by leaving behind an environmental mosaic that diversifies the landscape into different seral stages and habitats of varied quality (left). Some species are adapted to forest fires, such as pine trees that open their cones only after fire exposure (right).

Plants convert carbon dioxide into biomass and emit oxygen into the atmosphere. Approximately 350 million years ago (near the Devonian period) the photosynthetic process brought the concentration of atmospheric oxygen above 17%, which allowed combustion to occur. Fire releases CO_2 and converts fuel into ash and tar. Fire is a significant ecological parameter that raises many issues pertaining to its control and suppression in management. While the issue of fire in relation to ecology and plants has been recognized for a long time, Charles Cooper brought attention to the issue of forest fires in relation to the ecology of forest fire suppression and management in the 1960s. Fire creates environmental mosaics and patchiness to ecosystem age and canopy structure. Native North Americans were among the first to influence fire regimes by controlling their spread near their homes or by lighting fires to stimulate the production of herbaceous foods and basketry materials. The altered state of soil nutrient supply and cleared canopy structure also opens new ecological niches for seedling establishment. Most ecosystems are adapted to natural fire cycles. Plants, for example, are equipped with a variety of adaptations to deal with forest fires. Some species (e.g., *Pinus halepensis*) cannot germinate until after their seeds have lived through a fire. This environmental trigger for seedlings is called serotiny. Some compounds from smoke also promote seed germination.

Biogeochemistry

Ecologists study and measure nutrient budgets to understand how these materials are regulated and flow through the environment. This research has led to an understanding that there is a global feedback between ecosystems and the physical parameters of this planet including minerals, soil, pH, ions, water and atmospheric gases. There are six major elements, including H (hydrogen), C (carbon), N (nitrogen), O (oxygen), S (sulfur), and P (phosphorus) that form the constitution of all biological macromolecules and feed into the Earth's geochemical processes. From the smallest scale of biology the combined effect of billions upon billions of ecological processes amplify and ultimately regulate the biogeochemical cycles of the Earth. Understanding the relations and cycles mediated between these elements and their ecological pathways has significant bearing toward understanding global biogeochemistry. The ecology of global carbon budgets gives one example of the linkage between biodiversity and biogeochemistry. For starters, the Earth's oceans are estimated to hold 40,000 gigatonnes (Gt) carbon, vegetation and soil is estimated to hold 2070 Gt carbon, and fossil fuel emissions are estimated to emit an annual flux of 6.3 Gt carbon. At different times in the Earth's history there has been major restructuring in these global carbon budgets that was regulated to a large extent by the ecology of the land. For example, through the early-mid Eocene volcanic outgassing, the oxidation of methane stored in wetlands, and seafloor gases increased atmospheric CO_2 concentrations to levels as high as 3500 ppm. In the Oligocene, from 25 to 32 million years ago, there was another significant restructuring in the global carbon cycle as grasses evolved a special type of C4 photosynthesis and expanded their ranges. This new photosynthetic pathway evolved in response to the drop in atmospheric CO_2 concentrations below 550 ppm. Ecosystem functions such as these feed back significantly into global atmospheric models for carbon cycling. Loss in the abundance and distribution of biodiversity causes global carbon cycle feedbacks that are expected to increase rates of global warming in the next century. The effect of global warming melting large sections of permafrost creates a new mosaic of flooded areas where decomposition results in the emission of methane (CH_4). Hence, there is a relationship between global warming, decomposition and respiration in soils and wetlands producing significant climate feedbacks and altered global biogeochemical cycles. There is concern over increases in atmospheric methane in the context of the global carbon cycle, because methane is also a greenhouse gas that is 23 times more effective at absorbing long-wave radiation on a 100 year time scale.

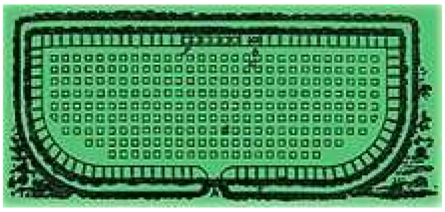
History

Unlike many scientific disciplines, ecology has a complex origin due in large part to its interdisciplinary nature. Several published books provide extensive coverage of the classics. In the early 20th century, ecology was an analytical form of natural history. The descriptive statistics of natural history included examination of the interaction of organisms with both their environment and their community. Such examinations, conducted by important natural historians including James Hutton and Jean-Baptiste Lamarck, contributed to the development of ecology. The term ‘ecology’ (German: *Oekologie*) is a more recent scientific development and was first coined by the German biologist Ernst Haeckel in his book *Generelle Morphologie der Organismen* (1866). By ecology we mean the body of knowledge concerning the economy of nature – the investigation of the total relations of the animal both to its inorganic and its organic environment; including, above all, its friendly and inimical relations with those animals and plants with which it comes directly or indirectly into contact – in a word, ecology is the study of all those complex interrelations referred to by Darwin as the conditions of the struggle of existence.

Ernst Haeckel (left) and Eugenius Warming (right), two founders of ecology

Opinions differ on who was the founder of modern ecological theory. Some mark Haeckel’s definition as the beginning, others say it was Eugenius Warming with the writing of Oecology of Plants: An Introduction to the Study of Plant Communities (1895). Ecology may also be thought to have begun with Carl Linnaeus’ research principles on the economy of nature that matured in the early 18th century. He founded an early branch of ecological study he called the economy of nature. The works of Linnaeus influenced Darwin in *The Origin of Species* where he adopted the usage of Linnaeus’ phrase on the *economy or polity of nature*. Linnaeus made the first to attempt to define *the balance of nature*, which had previously been held as an assumption rather than formulated as a testable hypothesis. Haeckel, who admired Darwin’s work, defined ecology in reference to the economy of nature which has led some to question if ecology is synonymous with Linnaeus’ concepts for the economy of nature. Biogeographer Alexander von Humbolt was also foundational and was among the first to recognize ecological gradients and alluded to the modern ecological law of species to area relationships. The modern synthesis of ecology is a young science, which first attracted substantial formal attention at the end of the

19th century (around the same time as evolutionary studies) and became even more popular during the 1960s environmental movement, though many observations, interpretations and discoveries relating to ecology extend back to much earlier studies in natural history. For example, the concept on the balance or regulation of nature can be traced back to Herodotos (died *c.* 425 BC) who described an early account of mutualism along the Nile river where crocodiles open their mouths to beneficially allow sandpipers safe access to remove leeches. In the broader contributions to the historical development of the ecological sciences, Aristotle is considered one of the earliest naturalists who had an influential role in the philosophical development of ecological sciences. One of Aristotle's students, Theophrastus, made astute ecological observations about plants and posited a philosophical stance about the autonomous relations between plants and their environment that is more in line with modern ecological thought. Both Aristotle and Theophrastus made extensive observations on plant and animal migrations, biogeography, physiology, and their habits in what might be considered an analogue of the modern ecological niche.



The layout of the first ecological experiment, noted by Charles Darwin in *The Origin of Species*, was studied in a grass garden at Woburn Abbey in 1817. The experiment studied the performance of different mixtures of species planted in different kinds of soils. From Aristotle to Darwin the natural world was predominantly considered static and unchanged since its original creation. Prior to *The Origin of Species* there was little appreciation or understanding of the dynamic and reciprocal relations between organisms, their adaptations and their modifications to the environment. While Charles Darwin is most notable for his treatise on evolution, he is also one of the founders of soil ecology. In *The Origin of Species* Darwin also made note of the first ecological experiment that was published in 1816. In the science leading up to Darwin the notion of evolving species was gaining popular support. This scientific paradigm changed the way that researchers approached the ecological sciences. Nowhere can one see more clearly illustrated what may be called the sensibility of such an organic complex, expressed by the fact that whatever affects any species belonging to it, must have its influence of some sort upon the whole assemblage. He will thus be made to see the impossibility of studying any form completely, out of relation to the other forms, the necessity for taking a comprehensive survey of the whole as a condition to a satisfactory understanding of any part.

After the Turn of the 20th Century

The first American ecology book was published in 1905 by Frederic Clements. In his book, Clements forwarded the idea of plant communities as a superorganism. This publication launched a debate between ecological holism and individualism that lasted until the 1970s. The Clements superorganism concept proposed that ecosystems progress through regular and determined stages of seral development that are analogous to developmental stages of an organism whose parts function to maintain the integrity of the whole. The Clementsian paradigm was challenged by Henry Gleason. According to Gleason, ecological communities develop from the unique and coincidental association of individual organisms. This perceptual shift placed the focus back onto the life histories of individual organisms and how this relates to the development of community associations. The Clementsian superorganism concept has not been completely rejected, but it was an overextended application of holism, which remains a significant theme in contemporary ecological studies. Holism was first introduced in 1926 by a polarizing historical figure, a South African General named Jan Christian Smuts. Smuts was inspired by Clement's superorganism theory when he developed and published on the unifying concept of holism, which runs in stark contrast to his racial views as the father of apartheid. Around the same time, Charles Elton pioneered the concept of food chains in his classical book 'Animal Ecology'. Elton defined ecological relations using concepts of food chains, food cycles, food size, and described numerical relations among different functional groups and their relative abundance. Elton's term 'food cycle' was replaced by 'food web' in a subsequent ecological text. Elton's book broke conceptual ground by illustrating complex ecological relations through simpler food web diagrams. The number of authors publishing on the topic of ecology has grown considerably since the turn of the 20th century. The explosion of information available to the modern researcher of ecology makes it an impossible task for one individual to sift through the entire history. Hence, the identification of classics in the history of ecology is a difficult designation to make.

Parallel Development

Ecology has developers in many nations, including Russia's Vladimir Vernadsky and his founding of the biosphere concept in the 1920s or Japan's Kinji Imanishi and his concepts of harmony in nature and habitat segregation in the 1950s. The scientific recognition or importance of contributions to ecology from other cultures is hampered by language and translation barriers. The history of ecology remains an active area of study, often published in the Journal of the History of Biology.

TEST 6

Part B

STRUCTURE AND WRITTEN EXPRESSION

Directions: In this part each problem consists of an incomplete sentence. Below the sentence are four choices marked (A), (B), (C), and (D). You should find the one choice which best completes the sentence.

1. The Clements superorganism … proposed that ecosystems progress through regular and determined stages of seral development that are analogous to developmental stages of an organism whose parts function to maintain the integrity of the whole.
(A) opinion
(B) theory
(C) concept
(D) thought

2. The … American ecology book was published in 1905 by Frederic Clements.
(A) first
(B) second
(C) third
(D) fourth

3. Awareness of humankind's effect on its environment … to Gilbert White in 18th-century Selborne, England.
(A) will have been traced
(B) had been traced
(C) has been traced
(D) have been traced

4. For example, the concept on the balance or regulation of nature can be traced back to Herodotos (died *c*. 425 BC) … described an early account of mutualism

along the Nile river where crocodiles open their mouths to beneficially allow sandpipers safe access to remove leeches.
(A) who
(B) whom
(C) which
(D) that
5. Nowhere can one see more clearly illustrated what may be called the sensibility of such an organic complex, expressed by the fact that … affects any species belonging to it, must speedily have its influence of some sort upon the whole assemblage.
(A) whoever
(B) whatsoever
(C) whatever
(D) whosoever
6. … many scientific disciplines, ecology has a complex origin due in large part to its interdisciplinary nature.
(A) Unlike
(B) Like
(C) Not like
(D) Not probable
7. The history of ecology, however, … with that of environmental thought.
(A) should be conflated
(B) should not be conflated
(C) would not be conflated
(D) will not be conflated
8. Ecology as a … science traces only from Darwin’s publication of Origin of Species and Haeckel’s subsequent naming of the science needed to study Darwin’s theory.
(A) modern
(B) old
(C) contemporary
(D) specific
9. These forces govern many of the geophysical properties and distributions of ecological … across the Earth.
(A) bees
(B) biomes
(C) algae
(D) ants

10. Turbulent forces in air and water have significant effects … the environment and ecosystem distribution, form and dynamics.
(A) for
(B) to
(C) in
(D) on

Part A **TEXT 7**

Ecology and Global Policy

Read and translate the text using a dictionary

Ecology became a central part of the World's politics as early as 1971, UNESCO launched a research program called *Man and Biosphere,* with the objective of increasing knowledge about the mutual relationship between humans and nature. A few years later it defined the concept of Biosphere Reserve. In 1972, the United Nations held the first International Conference on the Human Environment in Stockholm, prepared by Rene Dubos and other experts. This conference was the origin of the phrase 'Think Globally, Act Locally'. The next major events in ecology were the development of the concept of biosphere and the appearance of terms 'biological diversity'– or now more commonly biodiversity – in the 1980s. These terms were developed during the Earth Summit in Rio de Janeiro in 1992, where the concept of the biosphere was recognized by the major international organizations, and risks associated with reductions in biodiversity were publicly acknowledged. Then, in 1997, the dangers the biosphere was facing were recognized from an international point of view at the conference leading to the Kyoto Protocol. In particular, this conference highlighted the increasing dangers of the greenhouse effect – related to the increasing concentration of greenhouse gases in the atmosphere, leading to global changes in climate. In Kyoto, most of the world's nations recognized the importance of looking at ecology from a global point of view, on a worldwide scale, and to take into account the impact of humans on the Earth's environment.

Keystone Species

A keystone species is a species that is disproportionately connected to more species in the food web. Keystone species have lower levels of biomass in the trophic pyramid relative to the importance of their role. The loss of a keystone species results in a range of dramatic cascading effects that alters trophic dynamics, other food web connections and can cause the extinction of other species in the community.

Sea otters (*Enhydra lutris*) are commonly cited as an example of a keystone species because they limit the density of sea urchins that feed on kelp. If sea otters are removed from the system, the urchins graze until the kelp beds disappear and this has a dramatic effect on community structure. Hunting of sea otters, for example, is thought to have indirectly led to the extinction of the Steller's Sea Cow (*Hydrodamalis gigas*). While the keystone species concept has been used extensively as a conservation tool, it has been criticized for being poorly defined from an operational stance. It is very difficult to experimentally determine in each different ecosystem what species may hold a keystone role. Furthermore, food-web theory suggests that keystone species may not be all that common. It is therefore unclear how generally the keystone species model can be applied.

Ecosystem Ecology

These ecosystems, as we may call them, are of the most various kinds and sizes. They form one category of the multitudinous physical systems of the universe, which range from the universe as a whole down to the atom. The concept of the ecosystem was first introduced in 1935 to describe habitats within biomes that form an integrated whole and a dynamically responsive system having both physical and biological complexes. Within an ecosystem there are inseparable ties that link organisms to the physical and biological components of their environment to which they are adapted. Ecosystems are complex adaptive systems where the interaction of life processes forms self-organizing patterns across different scales of time and space. This section introduces key areas of ecosystem ecology that are used to inquire, understand and explain observed patterns of biodiversity and ecosystem function across different scales of organization.

The Biome

Ecological units of organization are defined through reference to any magnitude of space and time on the planet. Communities of organisms, for example, are somewhat arbitrarily defined, but the processes of life integrate at different levels and organize into more complex wholes. Biomes, for example, are a larger unit of organization that categorizes regions of the Earth's ecosystems mainly according to the structure and composition of vegetation. Different researchers have applied different methods to define continental boundaries of biomes dominated by different functional types of vegetative communities that are limited in distribution by climate, precipitation, weather and other environmental variables. Examples of biome names include: tropical rain forest, temperate broadleaf and mixed forests, temperate deciduous forest, taiga, tundra, hot desert, and polar desert. Other researchers have recently started to categorize other types of biomes, such as the human and oceanic microbiomes. To a microbe, the human body is a habitat and a landscape. The microbiome has been largely discovered through advances in molecular genetics that have revealed a hidden richness of microbial diversity on the planet. The oceanic microbiome plays a significant role in the ecological biogeochemistry of the planet's oceans.

Ecosystem Services and the Biodiversity Crisis


A bumblebee pollinating a flower, one example of an ecosystem service

Increasing globalization of human activities and rapid movements of people as well as their goods and services suggest that mankind is now in an era of novel coevolution of ecological and socioeconomic systems at regional and global scales. The ecosystems of planet Earth are coupled to human environments. Ecosystems regulate the global geophysical cycles of energy, climate, soil nutrients, and water that in turn support and grow natural capital (including the environmental, physiological, cognitive, cultural, and spiritual dimensions of life). Ultimately, every manufactured product in human environments comes from natural systems. Ecosystems are considered common-pool resources because ecosystems do not exclude beneficiaries and they can be depleted or degraded. For example, green space within communities provides common-pool health services. Research shows that people who are more engaged with regular access to natural areas have lower rates of diabetes, heart disease and psychological disorders. These ecological health services are regularly depleted through urban development projects that do not factor in the common-pool value of ecosystems. The ecological commons deliver a diverse supply of community services that sustains the well-being of human society. The Millennium Ecosystem Assessment, an international UN initiative involving more than 1,360 experts worldwide, identifies four main ecosystem service types having 30 sub-categories stemming from natural capital. The ecological commons include provisioning (e.g., food, raw materials, medicine, water supplies), regulating (e.g., climate, water, soil retention, flood retention), cultural (e.g., science and education, artistic, spiritual), and supporting (e.g., soil formation, nutrient cycling, water cycling) services. Policy and human institutions should rarely assume that human enterprise is benign. A safer assumption holds that human enterprise almost always exacts an ecological toll – a debit taken from the ecological commons. Ecological economics is an economic science that uses many of the same terms and methods that are used in accounting. Natural capital is the stock of materials or information stored in biodiversity that generates services that can enhance the welfare of communities. Population losses are the more sensitive indicator of natural capital than are species extinction in the accounting of ecosystem services. The prospect for recovery in the economic crisis of nature is grim. Populations, such as local ponds and patches of forest are being cleared away and lost at rates that exceed species extinctions. While we are used to thinking of cities as geographically discrete places, most of the land 'occupied' by their residents lies far beyond their borders. The total area of land required to sustain an urban region (its 'ecological footprint') is typically at least an order of magnitude greater than that contained within municipal boundaries or the associated built-up area. The WWF 2008 living planet report and other researchers report that human civilization has exceeded the bio-regenerative capacity of the planet. This means that human consumption is extracting more natural resources than can be replenished by ecosystems around the world. In 1992, professor William Rees developed the concept of our ecological footprint. The ecological footprint is a way of accounting the level of impact that human development is having on the Earth's ecosystems. All indications are that the human enterprise is unsustainable as the ecological footprint of society is placing too much stress on the ecology of the planet. The mainstream growth-based economic system adopted by governments worldwide does not include a price or markets for natural capital. This type of economic system places further ecological debt onto future generations. Human societies are increasingly being placed under stress as the ecological commons are diminished through an accounting system that has incorrectly assumed '... that nature is a fixed, indestructible capital asset'. While nature is resilient and it does regenerate, there are limits to what can be extracted, but conventional monetary analyses are unable to detect the problem. Evidence of the limits in natural capital is found in the global assessments of biodiversity, which indicate that the current epoch, the Anthropocene is a sixth mass extinction. Species loss is accelerating at 100 –1000 times faster than average background rates in the fossil record. The ecology of the planet has been radically transformed by human society and development causing massive loss of ecosystem services that otherwise deliver and freely sustain equitable benefits to human society through the ecological commons. The ecology of the planet is further threatened by global warming, but investments in nature conservation can provide a regulatory feedback to store and regulate carbon and other greenhouse gases. The field of conservation biology involves ecologists that are researching the nature of the biodiversity threat and searching for solutions to sustain the planet's ecosystems for future generations. Many human-nature interactions occur indirectly due to the production and use of human-made (manufactured and synthesized) products, such as electronic appliances, furniture, plastics, airplanes, and automobiles. These products insulate humans from the natural environment, leading them to perceive less dependence on natural systems than is the case, but all manufactured products ultimately come from natural systems. 'Human activities are associated directly or indirectly with nearly every aspect of the current extinction spasm'. The current wave of threats, including massive extinction rates and concurrent loss of natural capital to the detriment of human society, is happening rapidly. This is called a biodiversity crisis, because 50% of the world's species are predicted to go extinct within the next 50 years. The world's fisheries are facing dire challenges as the threat of global collapse appears imminent, with serious ramifications for the well-being of humanity. In a global study we will initiate the process of analyzing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation. Ecologists are teaming up with economists to measure the wealth of ecosystems and to express their value as a way of finding solutions to the biodiversity crisis. Some researchers have attempted to place a dollar figure on ecosystem services, such as the value that the Canadian boreal forest is contributing to global ecosystem services. If ecologically intact, the boreal forest has an estimated value of US $3.7 trillion. The boreal forest ecosystem is one of the planet's great atmospheric regulators and it stores more carbon than any other biome on the planet. The annual value for ecological services of the Boreal Forest is estimated at US $93.2 billion, or 2.5 greater than the annual value of resource extraction. The economic value of 17 ecosystem services for the entire biosphere (calculated in 1997) has an estimated average value of US $33 trillion ($10^{12}$) per year. These ecological economic values are not currently included in calculations of national income accounts, the GDP and they have no price attributes because they exist mostly outside of the global markets.

TEST 7

Part B

STRUCTURE AND WRITTEN EXPRESSION

Directions: In this part each problem consists of an incomplete sentence. Below the sentence are four choices marked (A), (B), (C), and (D). You should find the one choice which best completes the sentence.

1. Ecologists … with economists to measure the wealth of ecosystems and to express their value as a way of finding solutions to the biodiversity crisis.

(A) is teaming up

(B) are teaming up

(C) were teaming up

(D) was teaming up

2. These ecological economic values are not currently included in calculations of national income accounts, the GDP and they have no price attributes because they exist … outside of the global markets.

(A) mainly

(B) principally

(C) mostly

(D) for the most part

3. The current wave of threats, including massive extinction rates and concurrent loss of natural capital … the detriment of human society, is happening rapidly.

(A) to

(B) for

(C) in

(D) into

4. The ecology of the planet … radically … by human society and development causing massive loss of ecosystem services that otherwise deliver and freely sustain equitable benefits to human society through the ecological commons.

(A) has been … transformed

(B) have been … transformed
(C) had been … transformed
(D) would have … been … transformed
5. The ecosystems of planet … are coupled to human environments.
(A) Mercury
(B) Sun
(C) Moon
(D) Earth
6. The concept of the ecosystem was first introduced in … to describe habitats within biomes that form an integrated whole and a dynamically responsive system having both physical and biological complexes.
(A) 1925
(B) 1935
(C) 1945
(D) 1955
7. … of biome names include: tropical rain forest, temperate broadleaf and mixed forests, temperate deciduous forest, taiga, tundra, hot desert, and polar desert.
(A) Subjects
(B) Examples
(C) Items
(D) Issues
8. In 1972, the United Nations held the first international Conference on the Human Environment in Stockholm, prepared by Rene Dubos and other… .
(A) experts
(B) specialists
(C) thinkers
(D) intellectuals
9. The next major events in ecology … the development of the concept of biosphere and the appearance of terms 'biological diversity' – or now more commonly biodiversity – in the 1980s.
(A) is
(B) was
(C) were
(D) have been
10. Different researchers … different methods to define continental boundaries of biomes dominated by different functional types of vegetative communities that are limited in distribution by climate, precipitation, weather and other environmental

variables.
(A) has applied
(B) have applied
(C) had applied
(D) will have applied
11. The field of conservation biology involves ecologists that are researching the nature of the biodiversity threat and searching for solutions … the planet's ecosystems for future generations.
(A) to have sustained
(B) to be sustaining
(C) to sustain
(D) to have been sustaining

WORDLIST

aerobe – A bacterium requiring oxygen for life.
alga (pl. algae) – Any of a numerous class of plants that grow in sea and fresh water.
altruism – Zoology Instinctive behaviour that is detrimental to the individual but favours the survival or spread of that individual's genes, as by benefiting its relatives.
Ambystoma macrodactylum – The long-toed salamander (*Ambystoma macrodactylum*, Baird 1849) is a mole salamander in the family Ambystomatidae.
ameba – A one-celled animal that continually changes shape to engulf and absorb its food.
ancestor – A foregoing person or organism from whom one is descended.
anemophily – Anemophily or wind pollination is a form of pollination whereby pollen is distributed by wind.
anoxygenic – The term *anoxygenic* is most often used to describe the form of photosynthesis in purple bacteria, green sulfur bacteria, green non-sulfur bacteria, and heliobacteria.
ant – An ant is a small crawling insect that lives in large groups.
anthropology – It is the scientific study of people, their societies, cultures, etc.
anus – The anus is an opening at the opposite end of an animal's digestive tract from the mouth. Its function is to control the expulsion of feces.
aphid (C) – A type of small insect that feeds on the juices of plants.
arachnids – Arachnids are a class (*Arachnida)* of joint-legged invertebrate animals in the subphylum Chelicerata. All arachnids have eight legs, although in some

species the front pair may convert to a sensory function. The term is derived from the Greek word ἀράχνη (aráchnē), meaning ‘spider’.

arbuscular mycorrhizal fungi – Arbuscular mycorrhizal (AM) fungi are known to be well distributed throughout both hemispheres. These fungi can be isolated from a wide variety of natural habitats and are particularly abundant in cultivated lands.

area – An area is a particular part of a city, a country, or the world.

atmosphere – A planet’s atmosphere is the layer of air or other gas around it.

autotroph – An autotroph, also called a *producer*, is an organism that produces complex organic compounds (such as carbohydrates, fats, and proteins) from simple inorganic molecules using energy from light (by photosynthesis) or inorganic chemical reactions (chemosynthesis).

bacteria (sing. bacterium) – Very small living things, some of which cause illness or disease.

balance – A state of equilibrium.

beef – Beef is the meat of a cow, bull, or fox.

biocoenosis – A biocoenosis (alternatively, *biocoenose* or *biocenose*), termed by Karl Möbius in 1877, describes all the interacting organisms living together in a specific habitat (or biotope).

biome – Any community of plants and animals.

bioturbation – Bioturbation is the displacement and mixing of sediment particles (i.e. sediment reworking) and solutes (i.e. bio-irrigation) by fauna (animals) or flora (plants).

bizarre – Very unusual, strange.

boondoggle – Boondoggle may refer to: boondoggle (project), term for a scheme that wastes time and money.

boreal – Boreal is usually applied to ecosystems localized to subarctic (Northern hemisphere) and subantarctic (Southern hemisphere) zones, although Austral is also used for the latter. A ‘boreal forest’ also known as the Taiga, is the set of forest ecosystems that can survive in northern, specifically subarctic, regions.

Bradypodion spp. – Social display and colour variation in differently adapted species of chameleons.

bumblebee – A large, hairy, humming bee.

calorie – A calorie is a unit of measurement for the energy value of food.

canal – A canal is a long, narrow stretch of water that has been made for boats to travel along or to bring water to a particular area.

Cambrian period – The **Cambrian** is the first geological period of the Paleozoic Era, lasting from 542 ± 0.3 to 488.3 ± 1.7 Ma ago (ICS, 2004, chart); it is succeeded by the Ordovician.
carbon – Carbon is a chemical element that diamonds and coal are made of. All living things contain carbon.
carbon dioxide – Carbon dioxide is a gas. Animals and people breathe out carbon dioxide.
carnivore – A carnivore, meaning 'meat eater' (Latin *carne* meaning 'flesh' and *vorare* meaning 'to devour'), is an organism that derives its energy and nutrient requirements from a diet consisting mainly or exclusively of animal tissue, whether through predation or scavenging.
cat-to-clover – The cat-to-clover chain – an ecological cascade.
cave – It is a large natural hole in the side of the cliff or hill, or under the ground.
cerrado – The *cerrado* (English: ‘closed’ or ‘inaccessible’) is a vast tropical savanna ecoregion of Brazil, particularly in the states of Goiás and Minas Gerais.
chameleon – A lizard-like reptile that can adapt its colouration to that of its surroundings.
chlorine – Chlorine is a strong-smelling gas that is used to disinfect water and to make cleaning products.
clam – A clam is a kind of shellfish.
coastal – Coastal means in the sea or on the land near a coast.
commensalism – In ecology, commensalism is a class of relationship between two organisms where one organism benefits but the other is neutral (there is no harm or benefit). There are three other types of association: mutualism (where both organisms benefit), competition (where both organisms are harmed), and parasitism (one organism benefits and the other one is harmed).
common-pool resource – In economics, a *common-pool resource* (CPR), also called a *common property resource*, is a type of good consisting of a natural or human-made resource system (e.g. an irrigation system or fishing grounds), whose size or characteristics makes it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use.
community – A group of animal and plant species living together and having close interactions.
conservationist – A conservationist is someone who cares greatly about conservation.
conspecificity – Conspecificity is a concept in biology. Two or more individual

organisms, populations, or taxa are *conspecific* if they belong to the same species.
consume – To consume an amount of fuel, energy, or time means to use it up.
coral – A hard, horny skeleton of tiny marine animals.
crab – A crab is a sea creature with a flat round body covered by a shell, and five pairs of legs with large claws on the front pair.
crust – The outer layers of the Earth’s rocks.
daphnia – Daphnia are small, planktonic crustaceans, between 0.2 and 5 mm in length.
deforest – Clear of forests.
demography – The science of vital statistics relating to deaths, births, etc.
deplete – Exhaust by drawing away, as resources, strength, vital powers.
desert – A desert is a large area of land where there is very little water or rain and very few plants.
destruction – Destruction is the act of destroying something.
detritivores – Detritivores, also known as detritophages or detritus feeders or detritus eaters or saprophages, are heterotrophs that obtain nutrients by consuming detritus (decomposing organic matter).
detritus – Detritus generally refers to any disintegrated material or debris.
Devonian period –The **Devonian** is a geologic period and system of the Paleozoic Era spanning from 416 to 359.2 million years ago (ICS, 2004,[5] chart. period
diet – A diet is the food that a person or animal eats regularly.
disappear – If someone or something disappears, they go where you can no longer see them.
disease – A disease is an illness in living things that is caused by infection or by a fault inside them.
drought – A drought is a long period of time during which no rain falls.
earthquake – An earthquake is a shaking of the ground caused by the movement of the Earth’s crust.
Ecological commons – Ecological commons: seeing the environment as our common heritage.
ecologist – An ecologist is a person who studies the pattern and balance of relationships between plants, animals, people, and their environment
Ecology – Ecology is the study of the relationships between plants, animals, people, and their environment, and the balances between these relationships.
ecosphere – The part of the universe habitable by living organisms.
ecosystem – An ecological community.
Enhydra lutris – The sea otter (*Enhydra lutris*) is a marine mammal native to the

coasts of the northern and eastern North Pacific Ocean.

enthalpy – Enthalpy is a measure of the total energy of a thermodynamic system.

environment – The environment is the natural world of land, sea, air, plants, and animals that exists around towns and cities.

environmentalist – A person who works toward protecting the environment from destruction or pollution.

Eocene – The **Eocene Epoch**, lasting from about 56 to 34 million years ago (55.8 ± 0.2 to 33.9 ± 0.1 Ma), is a major division of the geologic timescale and the second epoch of the Paleogene Period in the Cenozoic Era.

epicentre – Epicentre is the place on the surface of the Earth that is right above the point where an earthquake begins inside the Earth.

erosion – Erosion is the gradual destruction or removal of something.

Eurymela fenestrata – Eurymela fenestrata, the common jassid, a leafhopper species in the genus Eurymela and the family Membracoidea; Euxesta fenestrata, a picture-winged fly species.

eusociality – Eusociality (Greek eu: 'good/real' + 'social') is a term used for the highest level of social organization in a hierarchical classification.

eutrophication – The depletion of the oxygen in water by algae, caused by excess phosphates, nitrates.

evolution – Evolution (also known as *biological*, *genetic* or *organic evolution*) is the change in the inherited traits of a population of organisms through successive generations.

extinct – A species of animals that is extinct no longer has any living members.

farming – Farming is the activity of growing crops or raising animals on a farm.

fig wasps – Fig wasps are wasps of the family Agaonidae which pollinate figs or are otherwise associated with figs, a coevolutional relationship that has been developing for at least 80 million years.

flood – If there is a flood, a large amount of water covers an area which is usually dry, for example when a river overflows.

food chain – All animals and plants are considerded as a group in which a plant is eaten by an insect or animal, which is then eaten by another animal and so on.

food web – A food web is a series of related food chains displaying the movement of energy and matter through an ecosystem.

fragile – Easily spoiled, harmed, or broken.

fungus (pl. fungi) – It is a simple type of plant that has no leaves or flowers and that grows on plants or other surfaces.

glacier – A glacier is a huge mass of ice which moves very slowly, often down a mountain valley.

global warming – The theory that the climate of the Earth is gradually becoming warmer as a result of the greenhouse effect.

globe – You can refer to the Earth as the globe.

grave danger – Danger that is grave is very serious and worrying.

gravitropism – Gravitropism is a turning or growth movement by a plant or fungus in response to gravity.

greenhouse effect – The global heating effect that is caused when the atmosphere is more transparent to incoming short-wave solar radiation than it is to outgoing long-wave radiation.

habitat – The habitat of an animal or plant is the natural environment in which it normally lives.

herbivores – Herbivores are organisms that are anatomically and physiologically adapted to eat plant-based foods.

holism – Holism (from ὅλος *holos*, a Greek word meaning *all*, *whole*, *entire*, *total*) is the idea that all the properties of a given system (physical, biological, chemical, social, economic, mental, linguistic, etc.) cannot be determined or explained by its component parts alone. Instead, the system as a whole determines in an important way how the parts behave.

holocoenotic – The theory that environmental factors act as a whole or aggregate in their effect upon organisms.

homeotherm – An organism, such as a mammal or bird, having a body temperature that is constant and largely independent of the temperature of its surroundings; an endotherm.

Hydrodamalis gigas – The last population of Steller's Sea Cow was discovered by a Russian expedition wrecked on Bering Island in 1741. The genus is thought to have become extinct by 1768.

Ice Age – The **Ice Age** is one of the long periods of time, thousands of years ago, when ice covered many northern countries.

immunology – The scientific study of the prevention of disease and how the body reacts to disease.

indicator – Something that can be regarded as a sign of something else.

insect – Any member of a class of tiny winged invertebrates.

insecticide – A substance to kill insects.

IQ – (**Intelligence Quotient)** Your level of intelligence, measured by a special test, with 100 being the average result.

intestine – It is the long tube in your body through which food passes after it leaves your stomach.

Iridomyrmex purpureus – Meat ants (Iridomyrmex purpureus), also known as meat-eater ants or gravel ants, are a species of ant belonging to the Iridomyrmex genus. They can be found throughout Australia.

irrigation –The artificial increase of water supply.

isomorphism – In abstract algebra, an *isomorphism* (Greek: ἴσος *isos* ‘equal’, and μορφή *morphe* ‘shape’) is a bijective map *f* such that both *f* and its inverse f^{-1} are homomorphisms, i.e., *structure-preserving* mappings.

land – Land is an area of ground with few or no buildings on it.

latitude – The latitude of a place is its distance to the North or South of the Equator.

leafhopper – Leafhopper is a common name applied to any species from the family *Cicadellidae*. Leafhoppers, colloquially known as *hoppers*, are minute plant-feeding insects in the superfamily Membracoidea in the order Homoptera.

leech – A small soft creature that fixes itself to the skin of animals in order to drink their blood.

lichen (U) – It is a grey, green, or yellow plant that spreads over the surface of stones and trees.

limestone – Limestone is a white-coloured rock which is used for building and making cement.

mammals – Mammals are particular types of animals.

man – 1. a mammal of the genus *Homo*; 2. a person; a human being; 3. the human race; mankind.

manure (U) – Manure is organic matter used as organic fertilizer in agriculture.

Mars – Mars is the small red planet that is fourth in order from the Sun and is nearest the Earth.

Mha – Million hectares.

media or mediums (sing. medium) – All of the organizations, such as television, radio, and newspapers, that provide news and information for the public, or the people who do this work.

metabolism – Metabolism is the set of chemical reactions that happen in living organisms to maintain life.

metapopulation – A metapopulation consists of a group of spatially separated populations of the same species which interact at some level. In Levins’ own words, it consists of ‘a population of populations’.

meteorite – A meteorite is a large piece of rock or metal from space that has landed on the Earth.

montane – In biogeography, *montane* is the highland area located below the

subalpine zone.
mortality – Mortality is the fact that all people must die.
motility – Motility is a biological term which refers to the ability to move spontaneously and actively, consuming energy in the process.
MtC – Metric tonne of carbon.
mutualism – Mutualism may refer to: Mutualism (biology), biological term often confused with symbiosis.
nematodes – Nematodes (pronounced /ˈnɛmətoʊdz/) or *roundworms* (phylum *Nematoda*) are the most diverse phylum of pseudocoelomates, and one of the most diverse of all animals.
Neolithic Age – The **Neolithic Age** is relating to the last period of the Stone Age, about 10,000 years ago, when people began to live together in small groups and make stone tools and weapons.
neotenes – The Texas Salamander (*Eurycea neotenes*) is a species of entirely aquatic, lungless salamander native to the United States.
nitrate – A chemical compound of nitric acid, used as a fertilizer.
nitric acid – A corrosive compound of nitrogen, used in making dyes, explosives, plastics, etc.
nitrogen – A colourless, odourless, gaseous element, No. 7, symbol **N**, forming four-fifths of the volume of the Earth's atmosphere.
occurrence – An occurrence is something that happens.
ocean – The ocean is the body of salt water covering three-fourths of the Earth's surface.
Oecology – The various relations of animals and plants to one another and to the outer world; now more commonly spelled {ecology}.
Oligocene – The **Oligocene** is a geologic epoch of the Paleogene Period and extends from about 34 million to 23 million years before the present (33.9 ± 0.1 to 23.03 ± 0.05 Ma).
omnivores – Omnivores (from Latin: *omni* all, everything; *vorare* to devour) are species that eat both plants and animals as their primary food source.
orogeny – Orogeny refers to forces and events leading to a severe structural deformation of the Earth's crust due to the engagement of tectonic plates.
osmoregulation – Osmoregulation is the active regulation of the osmotic pressure of an organism's fluids to maintain the homeostasis of the organism's water content; that is it keeps the organism's fluids from becoming too diluted or too concentrated.
oxide – A compound of oxygen with another element.
oxygen – A gaseous element, No. 8, symbol **O**, colourless, odourless, and essential

to all life.

ozone – An ionized form of oxygen.

Paleolithic Age – The **Paleolithic Age** is relating to the **Stone Age** (= the period of time thousands of years ago when people used stone tools and weapons).

panarchy – Panarchy is a conceptual term first coined by the Belgian botanist and economist Paul Emile de Puydt in 1860, referring to a specific form of governance (-archy) that would encompass (pan-) all others.

panicle – It is a compound raceme.

parasite – This is a plant or animal that lives on or in another plant or animal and gets food from it.

penicillin – It is a type of medicine that is used to treat infections caused by bacteria.

phylogenetics – In biology, *phylogenetics* is the study of evolutionary relatedness among various groups of organisms (for example, species or populations), which is discovered through molecular sequencing data and morphological data matrices.

Pinus halepensis – Pinus halepensis, commonly known as the *Aleppo Pine,* is a pine native to the Mediterranean region.

plankton – The microscopic animals and plants that drift freely in natural bodies of water and on which most marine life feeds.

poikilotherm – A *poikilotherm* is a plant or animal whose internal temperature varies along with that of the ambient environmental temperature. Most, but not all, terrestrial ectotherms are poikilothermic.

pole – The Earth's poles are the two opposite ends of its axis.

pollination – Pollination is the process by which pollen is transferred in plants, thereby enabling fertilization and sexual reproduction.

pollute – To pollute the water, air, or atmosphere means to make it dirty and dangerous to live in or to use.

ppm – Parts per million.

predation – In ecology, *predation* describes a biological interaction where a *predator* (an organism that is hunting) feeds on its *prey* (the organism that is attacked).

protein – Protein is a substance found, for example, in meat, eggs, and milk. You need protein in order to grow and be healthy.

quantity – A quantity is an amount that you can measure or count.

rabbit – It is a small animal with long ears and soft fur, that lives in a hole in the ground.

radiation – Radiation is very small particles of a radioactive substance that can cause illness and death.

rain forest – A rain forest is a thick forest of tall trees which is found in tropical areas where there is a lot of rain.

salamander – A mythical animal able to live in fire.

sandy dunes – Hills of sand heaped up by the wind.

sandpipers – The sandpipers are a large family, **Scolopacidae**, of waders or shorebirds.

savannah – It is a large flat area of grassy land, especially in Africa.

search for food – If you search for food, you look carefully for it.

seral – A seral community (or *sere*) is an intermediate stage found in ecological succession in an ecosystem advancing towards its climax community. In many cases more than one seral stage evolves until climax conditions are attained.

serotiny – Serotiny is an ecological adaptation exhibited by some seed plants, in which seed release occurs in response to an environmental trigger, rather than spontaneously at seed maturation.

shellfish – A shellfish is a small creature that lives in the sea and has a shell.

shoreline – The line where water and shore meet.

shrimp – A shrimp is a small shellfish with a long tail and many legs.

snail – A snail is a small animal with a long, slimy body and a spiral-shaped shell.

soil – Soil is the top layer of earth, which plants can grow in.

species – A species is a class of animals or plants whose members have the same main characteristics and are able to breed with each other.

staphylococcus (pl. staphylococci) – A parasitic bacterium.

starfish – A starfish is a flat, star-shaped creature with five arms that lives in the sea.

Stone Age – The **Stone Age** is a very early time in human history.

stratosphere – The region of the Earth’s atmosphere six to sixty miles above sea level.

survive – Continue to live.

symbiosis – Symbiosis (from the Greek: σύν *syin* ‘ with’; and βίωσις *biosis* ‘living’) is close and often long-term interactions between different biological species.

tapeworm – It is a long flat *worm* that lives in the bowels of humans and other animals and can make them ill.

taxon (pl. taxa) – It is a group of (one or more) organisms, which a taxonomist adjudges to be a unit.

termite – It is an insect that eats and destroys wood from trees and buildings.

toxin – A poisonous product of microorganisms.

tree – A large perennial plant with a single permanent woody trunk.
trophy – Denoting nourishment.
tundra – A level, treeless plain of Arctic regions.
turbulence – In fluid dynamics, turbulence or turbulent flow is a fluid regime characterized by chaotic, stochastic property changes. This includes low momentum diffusion, high momentum convection, and rapid variation of pressure and velocity in space and time.
vanish – If something vanishes, it disappears suddenly.
umwelt – According to Jakob von Uexküll and Thomas A. Sebeok, **umwelt** (plural: umwelten; the German word *Umwelt* means 'environment' or 'surrounding world') is the 'biological foundations that lie at the very epicentre of the study of both communication and signification in the human [and non-human] animal'. The term is usually translated as 'self-centred world'.
vegetation – Vegetation is plant life in general.
volcano – A volcano is a mountain which hot melted rock, gas, steam, and ash sometimes burst out of, coming from inside the earth.
waste – Waste is also material which has been used and is no longer wanted, for example because the valuable or useful part of it has been taken out.
water – Water is the clear, thin liquid that has no colour and no taste when it is pure.
watershed – A ridge off which water flows or drains.
wild – Animals living in the wild are living in their natural surroundings and are not being looked after by people.
worm – A worm is a small animal with a long thin body, no bones, and no legs, which lives in the soil.
WWF – World Wide Fund for Nature, a nature conservation organisation previously named World Wildlife Fund.
xeric shrublands – Deserts and xeric shrublands is a biome characterized by, relating to, or requiring only a small amount of moisture.
yucca – Yucca is a genus of perennial shrubs and trees in the agave family, Agavaceae. Its 40-50 species are notable for their rosettes of evergreen, tough, sword-shaped leaves and large terminal panicles of white or whitish flowers.
zooplankton – Zooplankton are the heterotrophic (sometimes detritivorous) type of plankton.

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з дисципліни
“Ділова іноземна мова”
(англійська мова)

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